A Scranton Gillette Publication

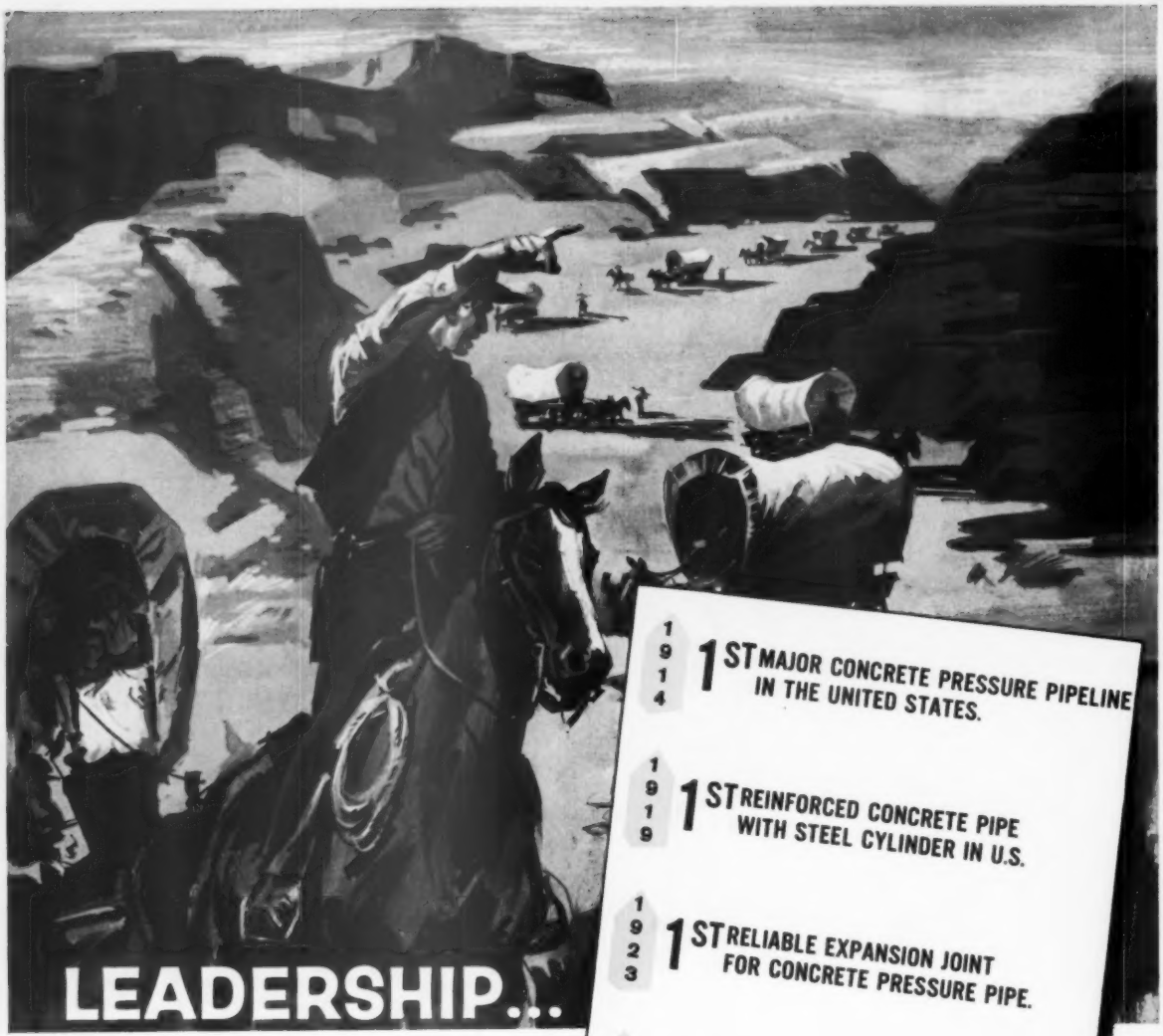
NOVEMBER 1961

# WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
COMP

**HARRY E. SCHLENZ**
New President of WPCF



# LEADERSHIP...

## Through Achievement

Pioneering new frontiers calls for leadership. LOCK JOINT PIPE COMPANY, pioneer in the field of concrete pressure pipe, has placed its name on every important milestone that marks the industry's progress.

**1914** 1ST MAJOR CONCRETE PRESSURE PIPELINE IN THE UNITED STATES.

**1919** 1ST REINFORCED CONCRETE PIPE WITH STEEL CYLINDER IN U.S.

**1923** 1ST RELIABLE EXPANSION JOINT FOR CONCRETE PRESSURE PIPE.

**1935** 1ST "O" RING TYPE RUBBER GASKET JOINT FOR PRESSURE PIPE.

**1942** 1ST PRESTRESSED CONCRETE PIPE WITH STEEL CYLINDER.

**1961** **NOW**— a new, NON-CYLINDER prestressed concrete pressure pipe—product of 56 years experience in the manufacture of concrete pipe, and developed through 24 years of research and 10 years of service testing in actual water works systems.

*For information, write for the brochure on:*

**LOCK JOINT PRESTRESSED CONCRETE PRESSURE PIPE**

Lock Joint Pipe Co. • East Orange, N. J.

Member of The American Concrete Pipe Association and The American Concrete Pressure Pipe Association

**Under construction, a complete city for living—and working!** When Palm Beach Gardens, Florida, is completed, it will be a self-contained city of 15,000 homes ...plus industrial plants, schools, churches, shopping center, golf course, landing strips for aircraft, and miles of man-made rivers.

# Florida's largest landowner selects "K&M" Asbestos-Cement Pressure Pipe for his "city of the future"

An ultra-modern "city of the future" is rising out of the fertile Florida loam, a few miles northwest of West Palm Beach: Palm Beach Gardens.

The daring and vision behind Palm Beach Gardens belongs to Mr. John D. MacArthur, Chicago insurance executive with a wide range of commercial interests.

No effort is being spared to insure homeowner satisfaction: one-acre lots, homes ranging from $9,000 to $30,000, fully mature trees as well as new plantings and all community services. For example, mountain spring water from Georgia, filtering through a hundred miles of underground gravel, will reach homes via "K&M"® Asbestos-Cement Pressure Pipe.

Mr. MacArthur has already installed 80,000 feet of 4″ through 16″ "K&M" Asbestos-Cement Pressure Pipe . . . plans to install another 600,000 feet, within the next two years.

Mr. MacArthur and his advisers studied water piping of all kinds, and in his own words:

Mr. John D. MacArthur, president of Bankers Life & Casualty Company, Chicago, Ill., and builder of Palm Beach Gardens, Florida.

# "We chose 'K&M' Asbestos-Cement Pressure Pipe over all available materials, foreign and domestic"

"Creating a new city is a great responsibility. The actual needs of the future generations can only be projected with imagination. Obviously the mistakes of our generation must be avoided. A system of streets anticipating the traffic flow, adequate parking, and a utility system built large enough to handle the maximum future requirements are essential. We selected 'K&M' Asbestos-Cement Pressure Pipe for our water lines only after my advisers had studied all available materials both domestic and foreign. We believe the coming generations will be spared the cost of repairs and replacements and our judgment will be confirmed."

There are good reasons for Mr. MacArthur's confidence in "K&M" Asbestos-Cement Pressure Pipe. It's nearly maintenance-free because it won't tuberculate, resists corrosion, and is immune to electrolysis. In addition, the exclusive, patented "K&M" FLUID-TITE® Coupling assures water-tight joints under all operating conditions.

As a result, taxpayers will enjoy the same water pressure and flow years hence, as they do now. Pumping costs through the years will remain low. Upkeep will be minimum. These tax savings will continue not only during the lifetime of present citizens, but for generations to come.

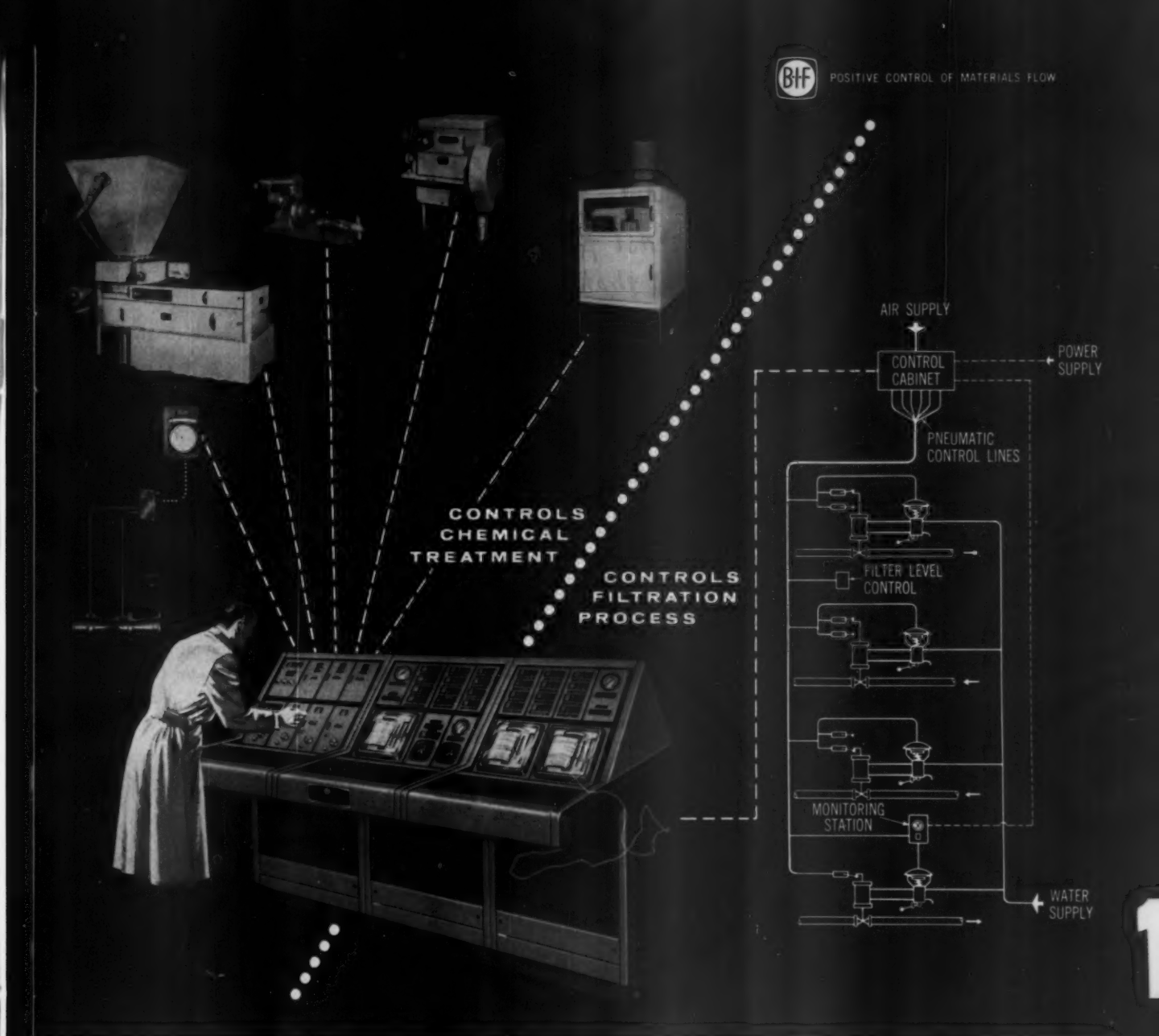
Discover why progressive communities from coast to coast choose "K&M" Asbestos-Cement Pressure Pipe. Write to: Keasbey & Mattison Company, Ambler, Pa.

K·M

Keasbey & Mattison at Ambler

Two easy steps will connect the pipe length to the FLUID-TITE® Coupling! Just lubricate and slide the pipe in. No heavy coupling pullers or machinery needed. Joint is permanently leak-tight.

"K&M" Asbestos-Cement Pressure Pipe installs swiftly and easily. In fact, you can lay it as fast as a shovel digs. Weather and soil conditions can't halt you. Lengths are easy to handle. You save time and labor costs.




# *New advanced concept!* **B-I-F** *laboratory control... more efficient water treatment for less money!*

ONE MAN CONTROL — From a single console in laboratory, the best qualified man (the plant chemist or chief operator) now has instant fingertip control over plant throughput, chemical additions, and filter backwash. This simplifies and improves process supervision . . . releases other manpower for more productive assignments.

MORE EFFICIENT FILTRATION — Centralized backwash control automatically initiates washing cycle . . . eliminates over or under washing and upset filter beds . . . allows key-man to make immediate, corrective adjustments over entire filtration and treatment process.

REDUCED COSTS — Overall plant construction costs reduced 15% to 20% by eliminating structures over filters. Chemical feeders located remotely for straight-line process flow . . . protects floc, improves settling, provides longer filter runs. Remote location of feeders also reduces maintenance cost by removing chemical dust problem from office and laboratory.

ANOTHER B-I-F 1st ! — Since the introduction of its Venturi Tube, 74 years ago, B-I-F has continuously developed new products and concepts in the municipal water treatment field. Today Laboratory Control makes your municipal bond dollar go farther by increasing filtration efficiency at lower cost.

REQUEST new Bulletin 2-1.20-1. Write **B-I-F Industries, Inc., 350 Harris Avenue, Providence 1, Rhode Island.**

B·I·F **Industries**

A DIVISION OF THE NEW YORK AIR BRAKE COMPANY

METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

# On Guard

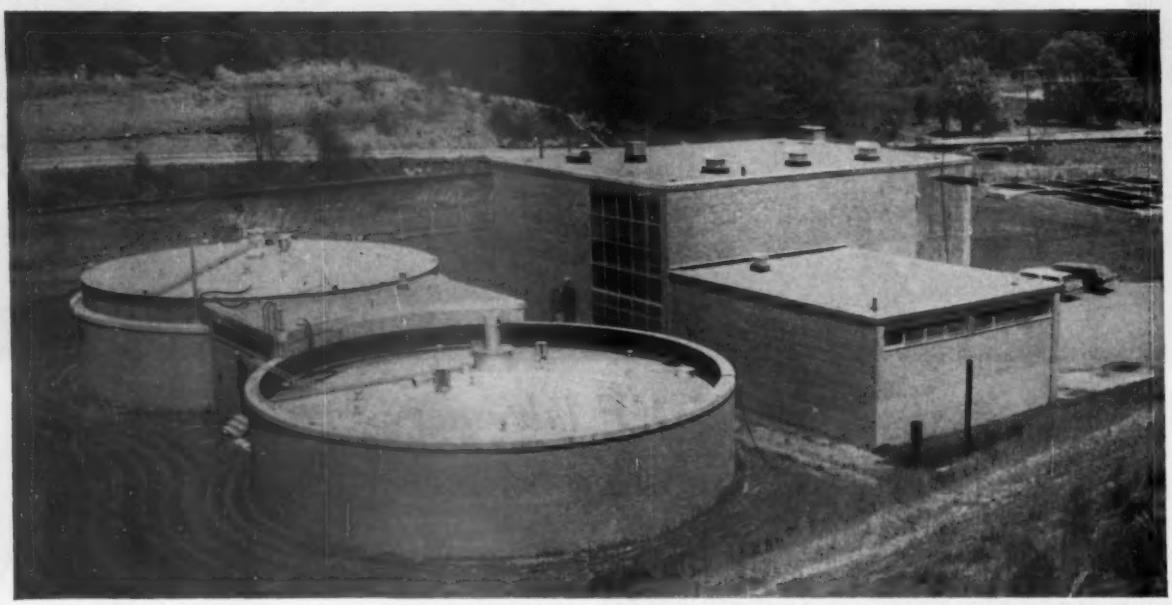
## *against pollution with P.F.T. equipment at Bethel, Pennsylvania*

The Borough of Bethel, Pennsylvania has become the fifth largest borough in population in the entire state even though it is only 65% developed.

Rapidly expanding, 400 new homes being built each year and increasing numbers of new industries moving into this area, Bethel's civic leaders have recognized the need of an efficient sewage treatment plant.

Today, this modern sewage treatment plant is a major factor in attracting new industries and assuring the healthy growth and development of this area.

The following P.F.T. equipment is giving Bethel a plant providing an effective and important health-guard for this community. 1 P.F.T. 55′ Floating Cover, 1 P.F.T. 55′ Spiral Guided Gas Holder; both provided with a P.F.T. Gas Recirculation System, P.F.T. Insulated Aluminum Roofing, 2 P.F.T. Liquidometer Cover Position Indicators with High and Low Level Alarms, 1 P.F.T. #750 Heater and Heat Exchanger Unit and P.F.T. Gas Safety Equipment.



Bethel's Sewage Treatment Plant Designed by Chester Engineers, Consulting Engineers, Pittsburgh, Pa.

P.F.T.

*waste treatment equipment exclusively since 1893*

**PACIFIC FLUSH TANK CO.**

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**WATER & SEWAGE WORKS**

**VOL. 108 NO. 11**

**NOVEMBER 1961**

*A Scranton Gillette Publication*

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OUR COVER—Harry E. Schlenz, new President of the Water Pollution Control Federation. See page 11-A.

Water & Sewage Works is published monthly with an extra issue in October. Subscriptions including the Reference Number issue in the U.S. and Canada, 1 year $5.00; 2 years $7.50; 3 years $10.00. Other countries $1.50 per year additional. Single copies 50c except Reference Number $1.00.

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Easy-Read Model A
frostproof design
⅝" through 1" x 1¼"

## Bigger face, better features make new Badger *Easy-Read** a standout

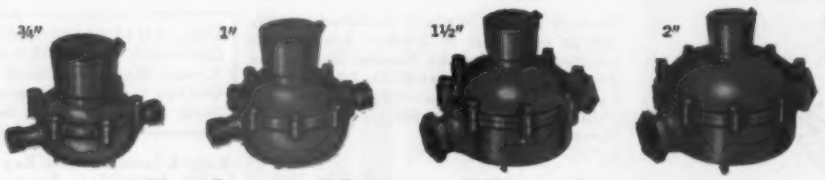
You're looking at the life-size face of the new Badger Easy-Read magnetic drive meter. Its biggest-face-in-the-industry (¼" high digits) is just one of Easy-Read's exclusives. Here's more:

**SEALED, REMOVABLE REGISTER** — Off comes its head without even disturbing the meter in the line. Easy-Read's register and cover can also be mounted in any of four positions for most convenient reading. Register and gear train parts operate in a clean, dry, lubricated, sealed housing to forever eliminate fogged registers.

**TRULY PERMANENT MAGNETIC COUPLING** — Easy-Read's ceramic magnets are made of high-quality barium alloy material — rustproof, noncorrosive, proven truly permanent. No stuffing box needed.

**INTERCHANGEABLE PARTS** — If yours is a Badger meter system, many parts in the new Easy-Read are interchangeable with the parts in your present meters.

Ask your Badger representative soon for a demonstration of the new Badger Easy-Read magnetic drive meter.




Split-case
Easy-Read meters
⅝" through 2"

*Trademark

## Badger Meter Mfg. Company

4545 West Brown Deer Road • Milwaukee 23, Wisconsin

# News—Here & There

## N. Central States Section AWWA Meeting

### MINNEAPOLIS, MINN.

**Sept. 13-15, 1961**

More than 250 N. Central States Section AWWA members were present at the Pick-Nicollet Hotel in Minneapolis for the 1961 meeting. They heard reports from the North Dakota and Minnesota State Health Departments, along with a report on water treatment technological advancements by Mr. Joseph Ling of the Minnesota Mining & Manufacturing Co., St. Paul. Preservation of ground water resources was covered by Mr. O. L. Kaupanger of the Minnesota Emergency Conservation Committee and protective paints were discussed by R. E. Mooney of the Michel Sales Company, Minneapolis.

A panel discussion on water rates was also a featured part of the program. Water supply legislation was discussed by Mr. D. J. Kennedy of the Leaque of Minnesota Municipalities. A new law protecting the Mississippi River water shed requires a permit to appropriate public waters for private use. New legislation also eliminated the requirements for voter approval to proceed with improvements to water service.

An interesting demonstration of water works **Safety** was presented by Mr. Duane Poole of the Ottertail Power Company in Fergus Falls, Minnesota. He emphasized that water works personnel should use proper hand insulating equipment when dealing with electrical problems. Personnel are particularly cautioned to observe extreme care when operating cranes, clam shells, and during excavation of trenches to avoid cutting buried cables. Marvin T. Skodge, Civil Engineering Department, North Dakota State College, described the origin of ground water aquifers in the Minnesota-North Dakota area. Artificial recharge is being considered in some areas, while in others, the trend is toward use of surface waters for potable supplies. J. W. Jones with the Halliburton Company, Houston, Texas, named four ways of stimulating water wells, including surging, shooting, hydrosonic, and pressure acidizing.

**WILLING WATER under a dozen feet of water at Fergus Falls, Minn. new filtration plant. Photo was taken through clear well sight glass.**

The new water treatment plant at Fergus Falls was described by Mr. Sidney Zeid of Consoer, Townsend and Associates, Chicago, Illinois. Mr. Howard Sowden, Superintendent at Fergus Falls, also participated in this presentation. The treatment plant, designed for hardness removal, can treat 5.0 mgd on a split treatment basis, or 7.5 mgd using all equipment in parallel operation.

Mr. John Cramer, President, AWWA, presented the Section's **Fuller award** to Clayton M. Bach, Superintendent of Filtration for the City of Minneapolis. The first place **advancement award** was presented to Northfield, Minn. Second and third place advancement certificates were presented to Fergus Falls and Moorehead, Minnesota, respectively. A comparison of **public relations** activities between electric utilities and water utilities was made by Dr. R. D. Furber of the Northern States Power Company, Minneapolis, Minn. He concluded that these two utilities have much in common and that effective operation and customer satisfaction depends on an understanding of

CONTINUED ON PAGE 10A

## Reader Response

**Gentlemen:**

" . . . Your editorial appearing in the September 1961 issue represented a point of view that most of us have heard many times before—mandatory certification is needed to assure communities that qualified personnel are operating the water utility which is so vital to the health of the community.

The theme of your editorial, however, seems to indicate that certification is so necessary that it **must** be made mandatory. To this I must raise the question—is the need so drastic that we should accept any kind of certification bill no matter how poorly it might be drawn, or how unsatisfactorily its machinery might be designed?

Illinois was not alone in turning down a mandatory certification bill in 1961. Our Pennsylvania Legislature did it, too."

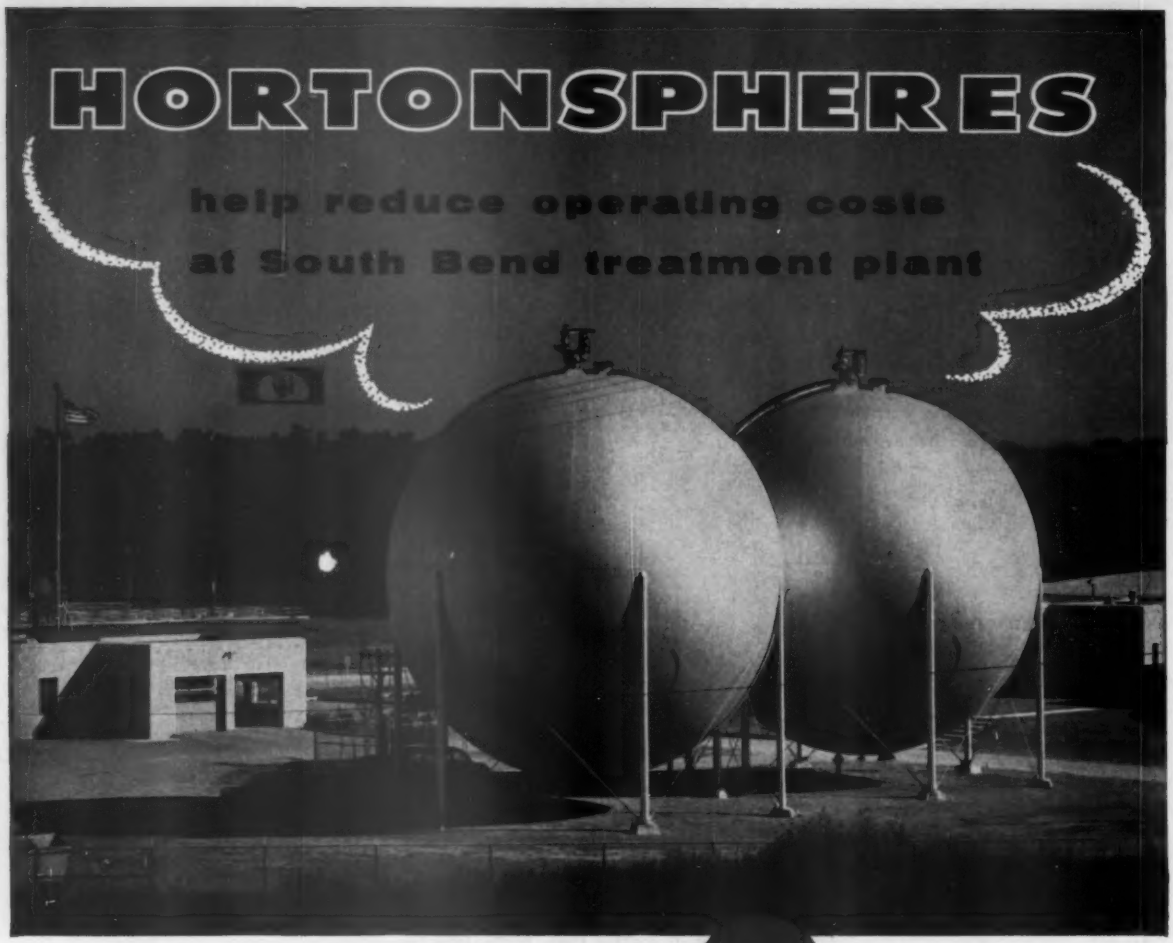
" . . . I personally felt that some provisions of the Bill were unsatisfactory and that the amendments which were suggested by the Eastern Water Company Conference would correct these points.

Although there were several minor things in the Bill as submitted to the Legislature to which I objected, the matter which I felt to be least practical was vesting authority for issuing and revoking operators' certificates entirely in the hands of the Secretary of Health of Pennsylvania. I felt that such authority should be vested in a Board made up of people who knew much about the practical problems of operation in addition to the Secretary of Health who may or may not have had such experience.

I do not know the provisions of the Illinois bill, but, I do know that I feel strongly about the Pennsylvania bill, and I would be unwilling to accept the Pennsylvania bill as drawn in order to get a certification bill of a kind.

To sum up the foregoing, I might say that a certification bill might be either a good bill or a bad bill, and if it is a bad bill, I do not think it worth "progress at any price."

**William T. Evans**
Executive Vice President
Shenango Valley Water Co.
Box 572
Sharon, Pennsylvania




South Bend, Indiana's sewage treatment system uses digester gas as low-cost fuel to drive sewage pumps and air compressors.

To equalize the variable gas production with demand, CB&I furnished these two 45 ft. diameter Hortonspheres®. Excess gas is stored in them at 40 lbs. per square inch working pressure—and released according to demand.

Hortonspheres are in demand *wherever* progressive operators seek to reduce sewage plant operating costs, for two reasons: Hortonspheres store *more* in *less* space; and, their performance is backed by seven decades of CB&I's craftsmanship in the design, fabrication and erection of steel plate structures.

Write your nearest CB&I office for details on Hortonspheres—for either digester gas or municipal gas service.

**3 WAYS SEWAGE PLANTS SAVE with HORTONSPHERES**

- Store more . . . in less space
- Smooth out pressure variations
- Provide peak load gas reserves

***Continuing improvements*** by CB&I in design, testing, fabricating, and erection techniques and equipment — plus new tougher steels with higher yield strength, have considerably extended the volume of gas that can now be stored at high pressure.

CB&I

Chicago Bridge & Iron Company
332 South Michigan Ave., Chicago 4, Ill.
*Offices and Subsidiaries Throughout the World*

# *Washington Viewpoint*

***

# News Here and There

CONTINUED FROM PAGE 7A

water utility problems by the public.

A review of synthetic detergents in water and sewage was presented by Dr. F. J. Coughlin of the Procter & Gamble Company, Cincinnati, Ohio. The toxicology of synthetic detergents has been accurately studied and the present public health standards permit a maximum of one-half ppm. This maximum is designed to meet safety, foaming and aesthetic standards of the consuming public. A diagram was used to illustrate the various relationships between degradability of hard and soft detergents. Ground water showing evidence of synthetic detergents may be considered a warning that the aquifer may be contaminated. It has been demonstrated, according to Dr. Coughlin, that the presence of synthetic detergents in ground waters has not measurably increased the rate of water travel underground.

New Chairman of the central states section is P. Buccowich, Jr., Ely, Minn.

## Resources Technology Division For RAI

A Resources Technology Division has been instituted for work in the areas of water purification, pollution control, waste disposal and water treatment, according to Munroe F. Pofcher, president of Radiation Applications Inc.

The new division will be directed by Dr. Herbert M. Schoen, who is also RAI's director of research.

Two new assistants are W. Wesley Eckenfelder, process consultant and professor of civil engineering at Manhattan College, and Dr. Elmer Gaden, RAI director and chairman of the chemical engineering department at Columbia University.

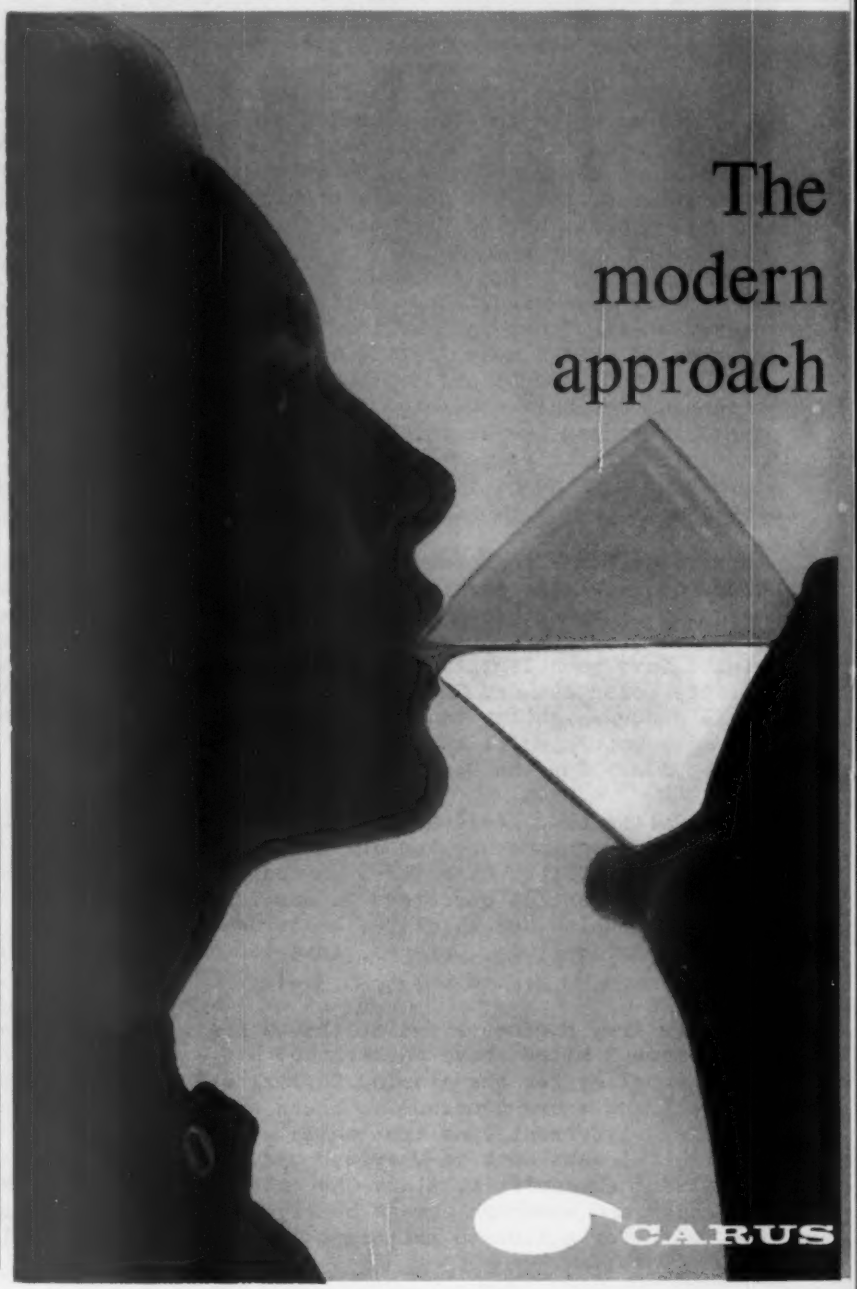
Radiation Applications Inc., located in Long Island City, is a research and development company active in the fields of atomic energy, radiation and polymer chemistry, chemical separations, plastics, and electrical insulation. It develops and manufactures plastic and chemical materials for the electronics and aerospace industries.

## Three Sanitary Engineers Chosen As "Outstanding"

Three of the 10 public works officials chosen from a large field of nominees as outstanding men in their field are sanitary engineers.

This announcement, made at the 67th annual meeting of the American Public Works Association, is part of a nation-wide effort to honor these and other public works officials at the local, state and federal levels.

David V. Auld, director of sanitary engineering, government of the District of Columbia; Robert H. Hess director of water and sewage treatment, Wichita, Kan.; and David B. Lee, director of sanitary engineering, Florida state board of health,



David Auld

Robert Hess

David Lee

Jacksonville, Fla., were three of the top 10 outstanding public works officials.

The men selected were chosen on merits, in high degree, of the professional excellence and record of valuable service to the community typical of public works officials.

The panel cited Auld for distinction in the management of Washington's water and sewage facilities, his work on the national planning commission and leadership in promoting water pollution abatement.

Hess' skill in operating the complex Wichita, Kan., water works and efforts on behalf of water pipeline research contributed to his selection.

Lee was cited for his wise counsel and advice to Florida officials on water and sewage problems.


to taste and odor control

CAROX* Potassium Permanganate

**Does the Job... and Does it Better... In Large or Small Water Systems**

You can provide *quality* water (and probably save money doing it!) with CAROX Potassium Permanganate. This extremely effective chemical removes obnoxious unpleasant tastes and odors caused by industrial wastes, decayed vegetation, and algae. It works quickly and efficiently, via oxidation and adsorption, to help provide safe, pure, palatable water.

You don't need any special equipment to use CAROX for water treatment; it works in virtually all conventional water treatment systems. The Potassium Permanganate method generally costs less to use than other prevalent techniques for eliminating tastes and odors; and, since it aids coagulation and serves as an effective biocide, it minimizes quantity requirements on other chemicals. CAROX is easy to handle, non-corrosive, and requires minimum storage space.

If you have taste and odor problems, you owe it to your community to investigate CAROX. Write to Carus Chemical Company, Inc., 1377 Eighth Street, LaSalle, Illinois, or phone 223-1500 for complete information.

*Trade Mark

CAROX **removes** ***musty, earthy, woody, moldy, swampy, grassy, fishy tastes and odors***

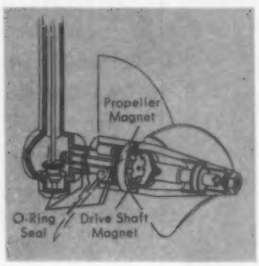
CAROX **destroys** ***hydrogen sulphide, phenols, chlorophenols, acrylates, mercaptans, organic herbicides, fungicides, insecticides***

CHEMICAL COMPANY, INC.


## ON THE COVER

Harry E. Schlenz, new president of the Water Pollution Control Federation, is the first manufacturer to be elevated to this position by the Federation. Long an active sanitary engineer, Schlenz is a graduate of the University of Illinois, holding an M. S. in civil engineering and the professional C. E. degree. He heads the Pacific Flush Tank Co. as president, and during the past year has been active as Federation vice-president. Born November 1, 1905. Instructor Water Supply and Engineering University of Illinois, 1927-1930. Joined PFT in 1930. Member Lake Geneva Committee of George Williams College; University of Illinois, Trustee Athletic Association; President Athletic Assn. of University of Illinois, 1953; Member American Society of Civil Engineers; Ill. Society of Engineers; American Public Works Assn.; American Academy of San. Engineers; Scabbard and Blade; Alpha Kappa Lambda; Sigma Xi; Tau Beta Phi; Chi Epsilon. Clubs: Barrington Hills Country Club; Army-Navy Club; Engineers (NYC). His home is in Barrington, Ill., where he lives with Mrs. Schlenz and their four children.

**DIRECT TOTALIZATION** on straight reading totalizer gives total flow information at a glance.




**MAGNET IN PROPELLER** assures a completely sealed meter transmission—eliminates packing gland. Requires no maintenance lubrication.

## Hermetically Sealed–Sparling Masterflo Main-line Meters Operate Perfectly-Even Submerged

**WATERPROOF • CORROSIONPROOF** • Wherever there is the hazard of a flooded meter pit or excessive exterior water the Sparling, hermetically sealed, Masterflo maintains accurate metering. Air-tight, water-tight Indicator-Totalizer continues to register direct totalization and show rate of flow under most adverse conditions to prevent service interruption, expensive downtime, loss of record, needless repair costs.

**MAGNETIC DRIVE** • Further meter protection is assured through the exclusive Sparling hermetically sealed head assembly. No water, grit or dirt can get into the water transmission. Dual radial magnets transmit propeller rotation through the sealed housing to the drive shaft eliminating packing glands; minimizing friction; locking out water. Excessive torque or load on the propeller will cause the magnets to "slip" before damage occurs. Lifetime lubrication is included in factory assembly.

The Sparling Masterflo is the ultimate in Main-line metering. Its performance, protection, dependability are worth the slight additional cost. Ask your Sparling field engineer.

**SPARLING**
WATER CONTROL EQUIPMENT

**HERSEY-SPARLING**
METER COMPANY
Sparling Equipment: **EL MONTE, CALIF.**
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# EQUIPMENT IN THE NEWS

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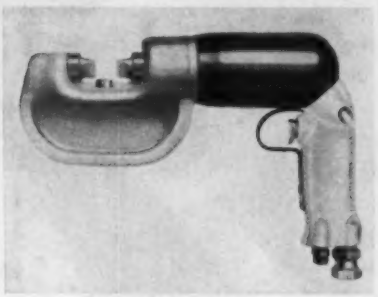
## Powerful Portable Power Cutters



This manufacturer announces the development of a series of highly portable Pneudraulic Rod Cutters, hand-held power tools capable of delivering up to 27½ tons of cutting force.

The ideal time-saver for snipping reinforcing bars, alloy steel rods and bolts up to 1 in. diameter, the Pneudraulic Rod Cutters are powered by a remotely controlled, portable power cell that converts normal shop air pressure into hydraulic pressures up to 7000 psi.

With this high degree of portability, the Pneudraulic (air-operated hydraulic) Rod Cutter can be used conveniently in-plant or in the field. There are no electrical components, hence the equipment can be used in damp or hazardous areas and in inclement weather.

Three sizes of Pneudraulic Rod Cutters are available. The smallest, weighing only 10½ pounds, is capable of delivering 12 tons of cutting force.—The Chicago Pneumatic Tool Co.

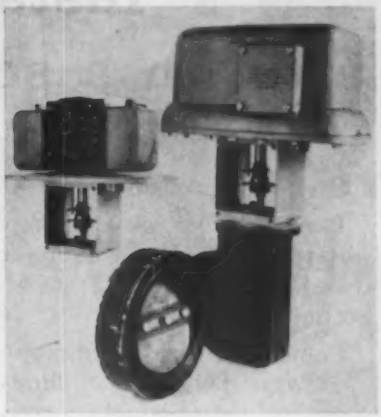
**Circle No. 1101 on Reader Service Card**

## Forced Feed Conveyor Loader

The new Forced Feed Conveyor Loader announced by Massey-Ferguson for its industrial line of equipment is shown mounted on the M-F 65 Utility Tractor. Note weather-protected side-mounted operator's cab. The conveyor, 30 in. wide and equipped with heavy ply rubber belting, attains a speed of 500 ft per minute. Engine speed is 1,500 rpm. Capacity is 5 to 8 cubic yards a minute in loose material. Over-all length is 25 ft; width, 7 ft; operating height, 11 ft; discharging height, 10 ft. Feeder blades, 33 in. long and 6 in. high, are made of ⅜-inch high carbon steel.—Massey-Ferguson Industrial Div.

**Circle No. 1102 on Reader Service Card**

## Heavy Duty Linear Actuator



The "DL-66", newest member of General Controls Co.'s family of versatile actuators, was introduced at the ISA Conference and Exhibit in Los Angeles. Offering a 1200-lb. maximum thrust, the new heavy-duty industrial linear actuator is designed for converting manually-operated valves or equipment in the field to remote or automatic operation. Versatile mounting of the "DL-66" permits speedy, easy installation without removing the valve or breaking lines

General Controls points out that the actuator is especially applicable to butterfly, ball, plug and gate valves, as well as dampers, variable speed drives and proportional pumps. Dependable service is assured on installations demanding up to 1200 lbs of thrust for actuation, including subsequent loads imposed by wear, corrosion, sludge, sediment, or mineral deposits.—Tork-Master Div., General Controls Co.

**Circle No. 1103 on Reader Service Card**

## Rockwell Permaturn Valves

A new concept in tapered plug valve design utilizing a high lubricity plastic coating that substantially reduces turning and provides lifetime maintenance-free operation was announced today by Rockwell Manufacturing Co.

Major new design feature of Permaturn valves is a high lubricity plug coating of the order of 0.0005-inch applied to tapered surfaces. For low pressure Permaturn valves—recommended for pressures up to 1000 psi—the coating is Teflon, a polyfluoride thermoplastic with an extremely high softening point. For high pressure services—up to 10,000 psi—Permaturn valves are coated with phosphate-molybdenum disulfide.—Rockwell Mfg. Co.

**Circle No. 1104 on Reader Service Card**

CONTINUED ON PAGE 18A

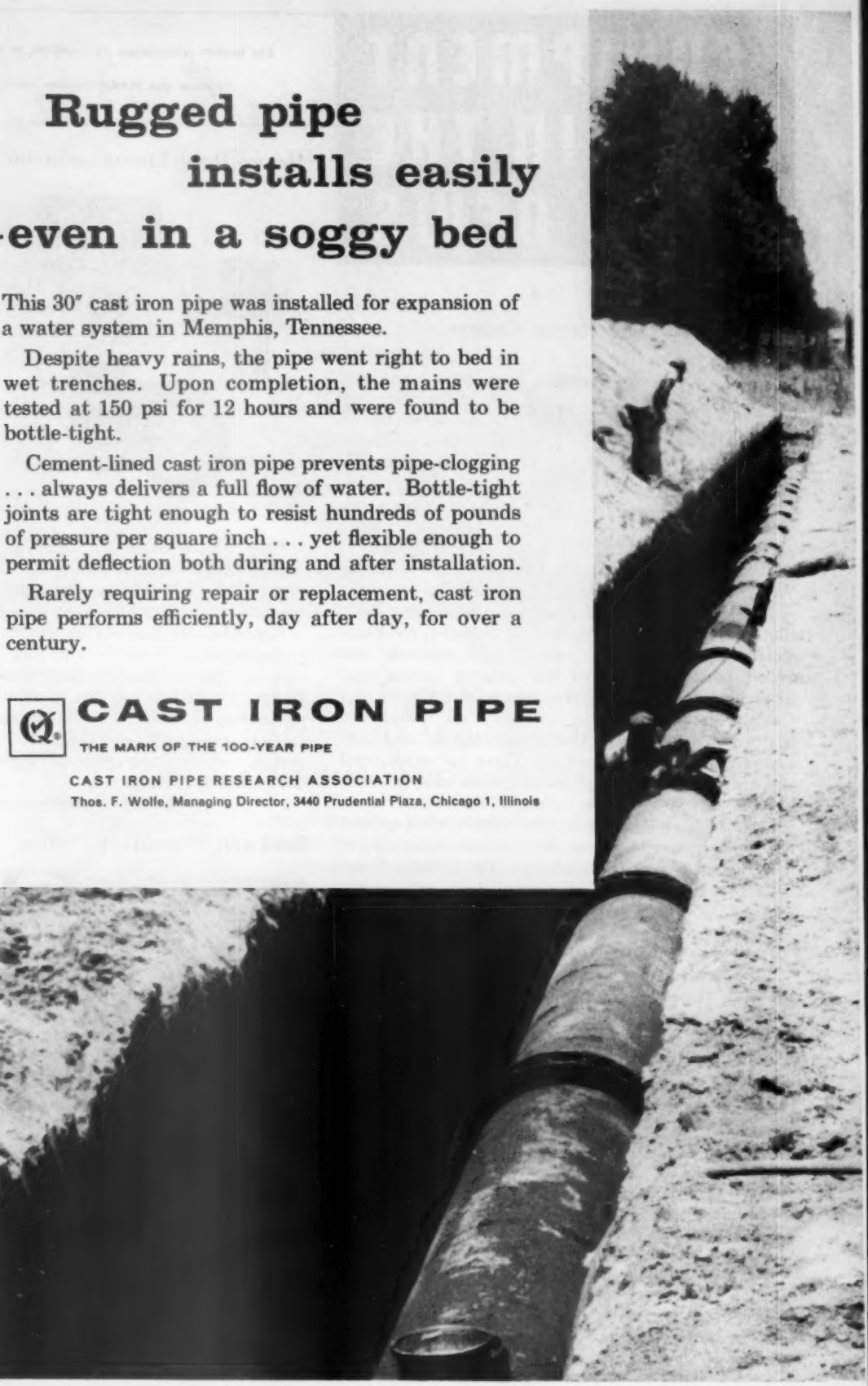
# Rugged pipe installs easily –even in a soggy bed

This 30″ cast iron pipe was installed for expansion of a water system in Memphis, Tennessee.

Despite heavy rains, the pipe went right to bed in wet trenches. Upon completion, the mains were tested at 150 psi for 12 hours and were found to be bottle-tight.

Cement-lined cast iron pipe prevents pipe-clogging . . . always delivers a full flow of water. Bottle-tight joints are tight enough to resist hundreds of pounds of pressure per square inch . . . yet flexible enough to permit deflection both during and after installation.

Rarely requiring repair or replacement, cast iron pipe performs efficiently, day after day, for over a century.



CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

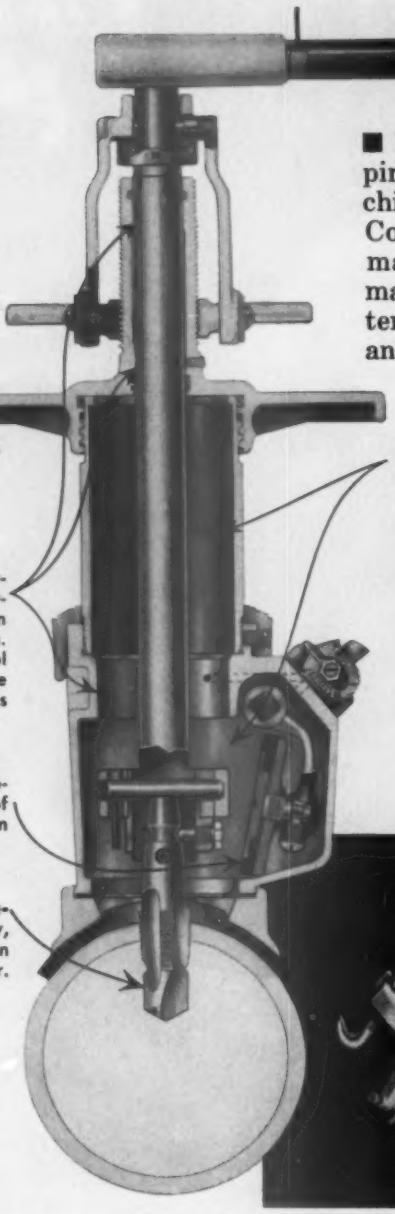
CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois

# *fast, trouble-free water service connections with the* **MUELLER B-100 MACHINE** *and* **MUELLER CORPORATION STOPS**

■ For over 90 years, the MUELLER Tapping Machine, MUELLER Tapping Machine Tools and the line of MUELLER Corporation Stops have been precisely matched in design and quality. This matched working team has given the Water Works industry its most dependable and economical service connections.

*designed for ease of operation— perfect alignment— accurate, watertight connections.*



**Three bearing design** of boring bar assembly assures perfect alignment with the main in all phases of operation. Absolute accuracy, longer tool life and ease of operation are dependable benefits of this engineering feature.

**Offset flap valve design** provides trouble-free means of isolating full water pressure in lower chamber.

**Matched Tool and Corporation Stop** design allows easy, accurate fit and alignment in attaching to the boring bar.

**Double Chamber design** permits the service connection to be made under full water pressure in two separate operations—first the main is drilled and tapped; second, the corporation stop is inserted in the threaded hole in the main. *This is accomplished without interrupting water service and with no loss of water.*

Double Chamber design permits the machine to be handled in lightweight sections. The base section of the machine, which contains the valve chamber, is rigidly attached to the main. The top section, with the boring bar assembly, is removable. This gives complete flexibility of operation, such as allowing the tool or stop to be removed at any time during the operation, or permitting the extraction and replacement of old corporation stops.

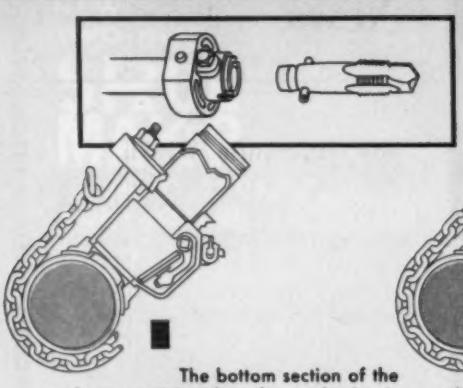
*design matched and precisely manufactured to work together.*

**Corporation Stop Thread design** is perfectly mated to tapping tool thread to insure accurate, watertight connection to the main.

*For additional information, consult your Mueller representative or write direct.*

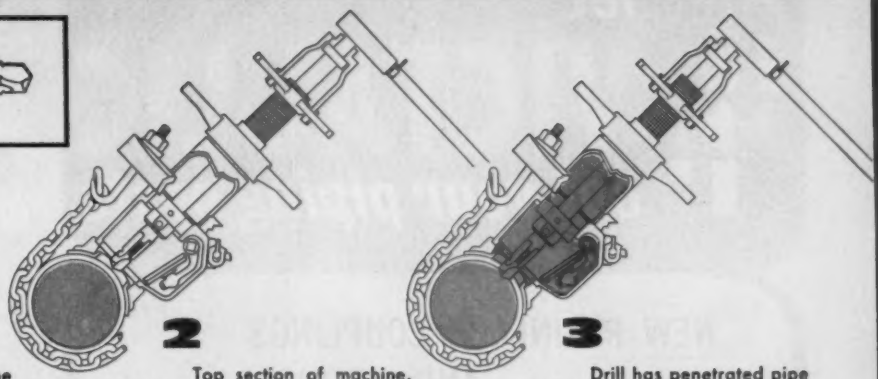
## *the inside story . . .*

**This time-proven method of drilling and tapping the main and inserting the stop under pressure guarantees trouble-free water service connections.**



**1**

The bottom section of the machine containing the valve mechanism is secured to the main. The drilling and tapping tool is attached to the top section with boring bar assembly.

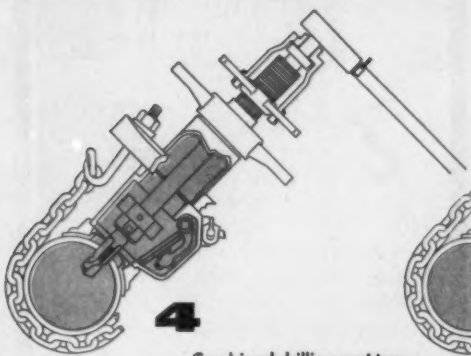


**2**

Top section of machine, with drilling and tapping tool attached to boring bar, is secured to base section. Flop valve has been opened and boring bar lowered to drilling position.

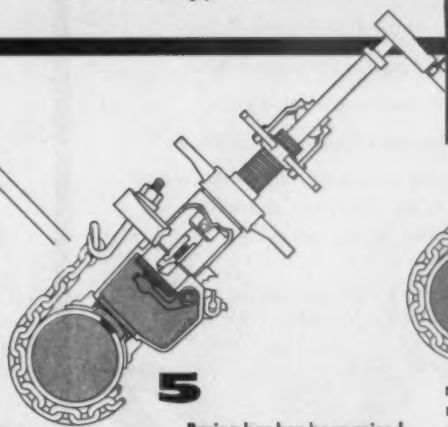
**3**

Drill has penetrated pipe wall—full water pressure is being controlled within entire body of machine. B-100 Machine can be either hand or power operated.



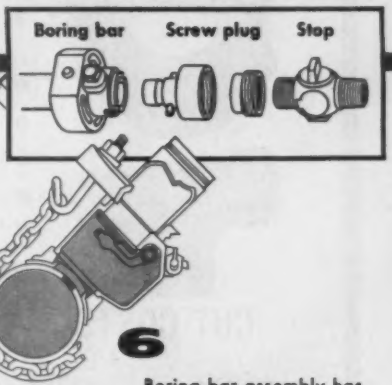
**4**

Combined drilling and tapping tool has now penetrated deeper into the main to cut accurate, matching threads for insertion of corporation stop.



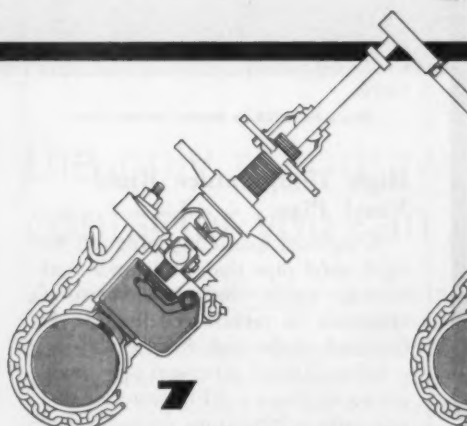
**5**

Boring bar has been raised above the lower body chamber. Flop valve is closed to confine water pressure to lower chamber. Entire boring bar assembly can now be removed without loss of water.



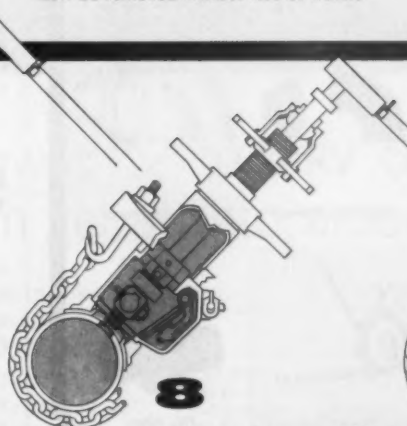

**6**

Boring bar assembly has now been removed from lower section of machine. At this point, the matching corporation stop is attached to the boring bar, replacing the drilling and tapping tool. Boring bar assembly can now be repositioned on machine without disturbing flop valve or water pressure.



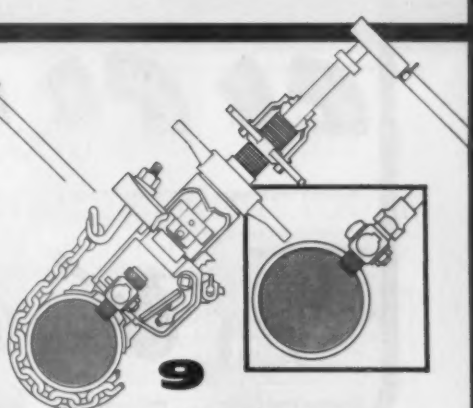
**7**

The boring bar assembly with stop attached is replaced on base section of machine. The precise alignment with the tapped hole is again assured for the insertion operation.



**8**

Boring bar assembly is lowered—matching threads of corporation stop and tapped hole allow easy, trouble-free insertion into main.



**9**

Watertight service connection to main completed. Machine can be removed and service piping attached to closed corporation stop. Stop is then opened to activate water service.

**MUELLER CO.** **DECATUR, ILL.**

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited; Sarnia, Ontario

6374

let VICTAULIC cut your piping costs

NEW PLAINLOCK COUPLINGS AND FITTINGS

For Low Cost Jointing of Plain End Pipe

- Speed Installation — Save Time and Labor — Cut Piping Costs
- No pipe end preparation
- Positive grip of pipe ends
- Low cost couplings and fittings
- Join standard or light wall carbon or stainless steel, aluminum and other piping materials

CUT COSTS WITH OVER 1100 VICTAULIC ITEMS FOR BETTER AND EASIER PIPING

Standard Couplings

Lightweight Couplings

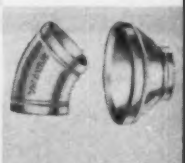
Snap-Joint Couplings

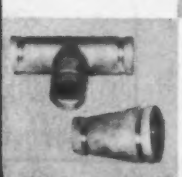
Rigid Couplings

Malleable Iron Fittings

Lined Fittings

Cast Iron Fittings


Aluminum Fittings


Stainless Steel Fittings

Vic-Groover Tools

Vic-Easy Tools

Plug Valves

For complete information on any Victaulic product, write:

VICTAULIC COMPANY OF AMERICA

P.O. Box 509, Elizabeth, N.J.

# Equipment News

CONTINUED FROM PAGE 13A

## New Hydraulic Winch

A new, completely hydraulic winch, identified as Model 10 Pippin Hydraulic Winch, capable of line pull of more than 17,000 lbs, has been announced by this manufacturer of backhoes and loaders.

Available with either larger cylinders for more power or smaller cylinders for more speed, the Pippin Hydraulic Winch is constructed of fabricated steel. The new winch is easy to install and fits all tractors. It can be used wherever hydraulic power is available—no power take-off is required. It may also be powered by an electric motor-driven hydraulic pump.—Windsor Pippin Corp.

**Circle No. 1105 on Reader Service Card**

## High Temperature Rigid Vinyl Pipe

A national marketing program for rigid vinyl pipe that withstands both boiling water and hot corrosive chemicals is announced by B. F. Goodrich Industrial Products Co.

"High-Temp" Koroseal pipe, manufactured from a BFG material that was only a laboratory curiosity just two years ago, is now on sale coast-to-coast. The new pipe is described as the first significant breakthrough in the vinyl industry since development of the first rigid vinyl 13 years ago. High-Temp piping withstands

CONTINUED ON PAGE 88A

*SpaceMaker* is an Allis-Chalmers trademark.

# the only real drawout 2- to 5-kv controller...with a contactor you can get at, into, around...without tools

▲ This means no unbolting—no wires to unfasten. You rack the contactor to "disconnect position" with the door closed. Open door. Roll contactor carriage out. It's that simple, that quick . . . and safe. ● Inspection? Lift out arc chutes and barriers. Rotate pole pieces to fully expose contact structure. Fuses? Lift them out, too. No tools, all the way. ■ SPACEMAKER control. First dramatic new achievement in high-voltage motor control in more than a decade. To learn more about the many cost-cutting features, call your A-C distributor or representative. Or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

**LET'S COMPARE THESE FEATURES**

| | SpaceMaker Controller | Controller "A" | Controller "B" |
|---|---|---|---|
| Two starters in 90" height | Yes | No | No |
| Drawout construction | Complete | Partial | No |
| Simultaneously disconnects all six main leads (line and load) | Yes | Line Only | Line Only |
| Automatic shutters isolate line | Yes | Yes | No |
| "No-tool" inspection of contacts | Yes | No | No |
| Track-resistant, flame-retardant insulation | Yes | No | No |
| Contactor construction | Double Break | Single Break | Single Break |
| Overload relays visible from outside | Yes | No | No |

**ALLIS-CHALMERS**

A-1521

NEW,
DRAWOUT
SPACE MAKER
HIGH-VOLTAGE
CONTROLLER

SPACEMAKER control at Stratman pumping station: (from left to right) 1. Auxiliary controls. 2. Fused disconnect switch (upper) and spare cubicle (lower). 3. Synchronous control. 4. Wound-rotor control (upper) and squirrel-cage control (lower).

# New SpaceMaker control eliminates costly floor-rebuilding for St. Louis County Water Company

Privately owned St. Louis County Water Company serves more than 160,000 customers in a 225-square-mile area adjoining St. Louis, Mo. This progressive utility recently replaced an obsolete panelboard in a "cramped" pumping station with new *SpaceMaker* high-voltage motor control.

Allis-Chalmers new, exclusive two-high design enabled the utility to install all needed controllers in a single lineup. This permitted use of existing conduit without changes — thus saving cost of conduit relocation and floor reconstruction. Other controllers would have required a back-to-back layout.

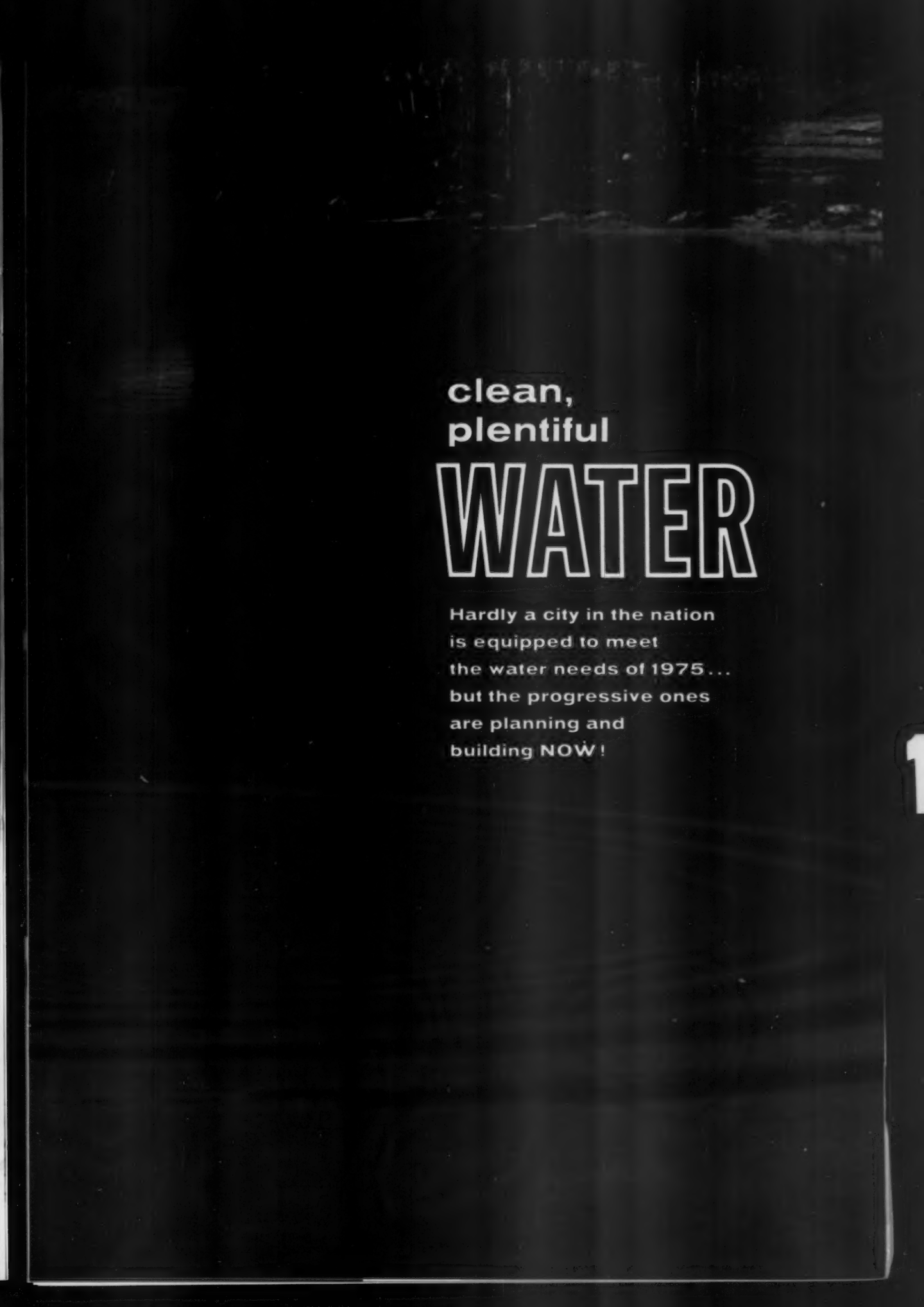
Equally important: the single lineup of *completely* drawout front access controllers saved valuable aisle space.

To learn more about the *exclusive* cost-cutting, space-saving features of *SpaceMaker* control, contact your A-C representative or write **Allis-Chalmers,** Industrial Equipment Division, Milwaukee 1, Wis.

Single cage controller in compact enclosure measuring 45 inches high, 36 inches wide and 32 inches deep.

*SpaceMaker* is an Allis-Chalmers trademark.

**ALLIS-CHALMERS** A-C ALLIS-CHALMERS A-1532


clean,
plentiful
WATER
Hardly a city in the nation
is equipped to meet
the water needs of 1975...
but the progressive ones
are planning and
building NOW!

## "WHERE WATER'S CONCERNED, THERE IS SIMPLY NO ALTERNATIVE TO PLANNING AHEAD!"

*says R. LEWIS BARTON, Oklahoma City*

"Our decision to establish a new water supply was based on the knowledge that Oklahoma City's future growth and prosperity were at stake. Our population has increased 33.2% in the past decade. By the year 2000 we estimate a further gain of 66% over today's population.

"Industry, too, is moving in. We feel certain that Western Electric would never have erected their new $36-million plant without assurance of adequate future water supplies. Then there's the new FAA Aeronautical Center which will eventually employ five thousand people. And with completion in 1963 of the new water line from the Atoka Reservoir, we'll be ready for any industry!"

**Mr. Barton** is Trustee and Chairman of the Oklahoma City Municipal Improvement Authority.

## MODERN FILTER PLANT READY TO HANDLE POPULATION GROWTH OF THE NEXT 20 YEARS!

Pumping 12 million gallons per day, the new Hoskins Filter Plant at Charlotte, North Carolina, has increased the city's water supply by 50%. And as the city grows, so will the capacity of the filter plant. It is designed to supply an ultimate of 72 million gallons per day—more than enough water to provide for the 420,000 population expected by 1979.

And the new plant will remain an attractive addition to its industrial neighborhood. Precast panels of concrete form the walls. Their lively texture and color will keep the building looking clean and modern through years of service to the community.

**Hoskins Filter Plant,** owned and operated by the city of Charlotte, North Carolina.

**Over 99 miles** of 60-in. concrete pressure pipe will carry water to Oklahoma City from its new source at Atoka Reservoir in southeastern Oklahoma.

**In 1850,** Napoleon was on a main water transportation route of the Great Lakes area.

## NEW CHARLOTTEBURG DAM AND RESERVOIR HELP NEWARK MEET ITS UNIQUE WATER SUPPLY PROBLEM

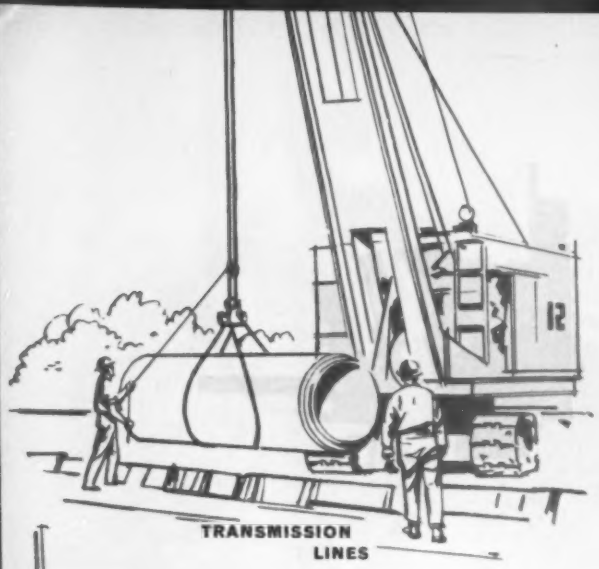
Busy, bustling Newark, New Jersey, is the only city in the United States whose population *doubles* during daylight hours. The newest project in the city's continuing program of water improvements is the Charlotteburg Dam. This new reservoir provides an additional storage capacity of 2.9 billion gallons from the Pequannock River watershed. Construction of the project provides for the most efficient use of the four existing reservoirs in the area.

**Charlotteburg Dam,** largest mass concrete dam in New Jersey, is 685 feet in length and 87½ feet high.

## NEW WATER LINES WILL BRING INDUSTRIAL GROWTH TO NAPOLEON, OHIO!

Located on the Maumee River, Napoleon has an abundant water supply. But without proper treatment and distribution facilities Napoleon has not been able to promise relocating industries all the water they needed. And industry has been passing the town by.

Now, you see new asbestos-cement pipelines going in all over town. Plans move ahead for a new treatment plant to double present capacity, allow for even more expansion in the future. Napoleon is back in the business of growing . . . with assurance that new manufacturers will soon be bidding for choice industrial sites.

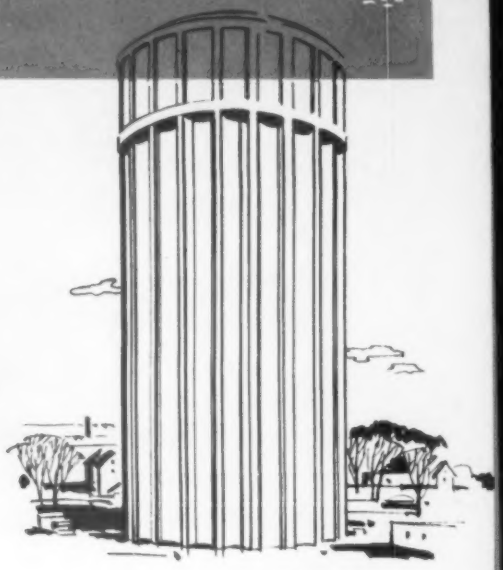


TRANSMISSION LINES

DAMS

DISTRIBUTION LINES

# CEMENT TAKES ON A VITAL ROLE



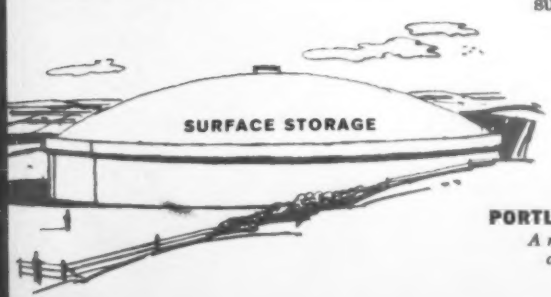
ELEVATED STORAGE

TREATMENT

Across the nation, modern living soaks up water *by the billions of gallons* for washing machines, air conditioners, extra bathrooms. By the 1980's, more than 200,000,000 Americans in urban communities will need 28 to 32 billion gallons of water *every day*. This totals nearly twice the present day demand for water in our cities and towns.

Everywhere today, the need for new water sources, new treatment, storage and distribution facilities is urgent. In such a total program, of course, cement earns a vital role. The strength of concrete, asbestos-cement and other cement products, their durability, and potential for beauty as well as efficiency, make them favored products for planners and builders.

Engineers in nationwide offices of the Portland Cement Association cooperate with city planners and engineers, supply up-to-date information on the newest uses of portland cement for modern water facilities. For details, contact your local PCA office.



SURFACE STORAGE

**PORTLAND CEMENT ASSOCIATION**

*A national organization to improve and extend the uses of concrete*

**MODERN Concrete**

Regular Submersible

# SUBMERSIBLE PUMPS

## deliver water

**economically**

**consistently**

**silently**

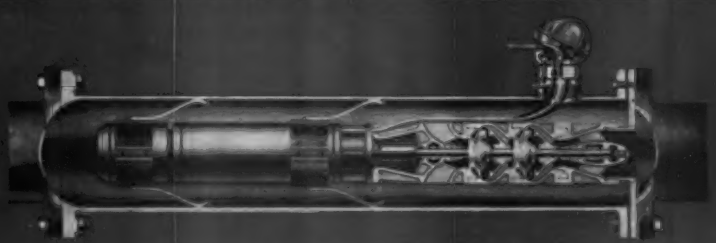
**efficiently**

The Layne Submersible Pump installation gives you noise free operation because the pump and motor are completely submerged. The Layne Submersible is adaptable to all wells; requires a minimum of space since no pump house is required; eliminates possibility of water contamination; and eliminates the opportunity for vandalism or other accidental mishap or damage.

Layne Submersible Pumps are available for wells as small as 6 inches and in capacities from 30 GPM up. For additional information write for free bulletin number 202.

The Layne In-Line Submersible pump provides the answer to many problems in booster pump applications. The pump operates as an integral part of the line and is designed for use by municipalities, industry, such as petroleum and chemical plants and by agriculture. Advantages include: simple installation, no additional space required, continuous service even under flood conditions, and no possibility of surface water contamination.

Layne In-Line pumps are made as small as 4 inch bowls on a 4 inch motor for use in a 6 inch pipe to deliver 30 GPM. Larger sizes are available as required. For additional information write for free bulletin number 203.



In-Line Submersible

Layne SINCE 1882 — COMPLETE WATER SERVICE

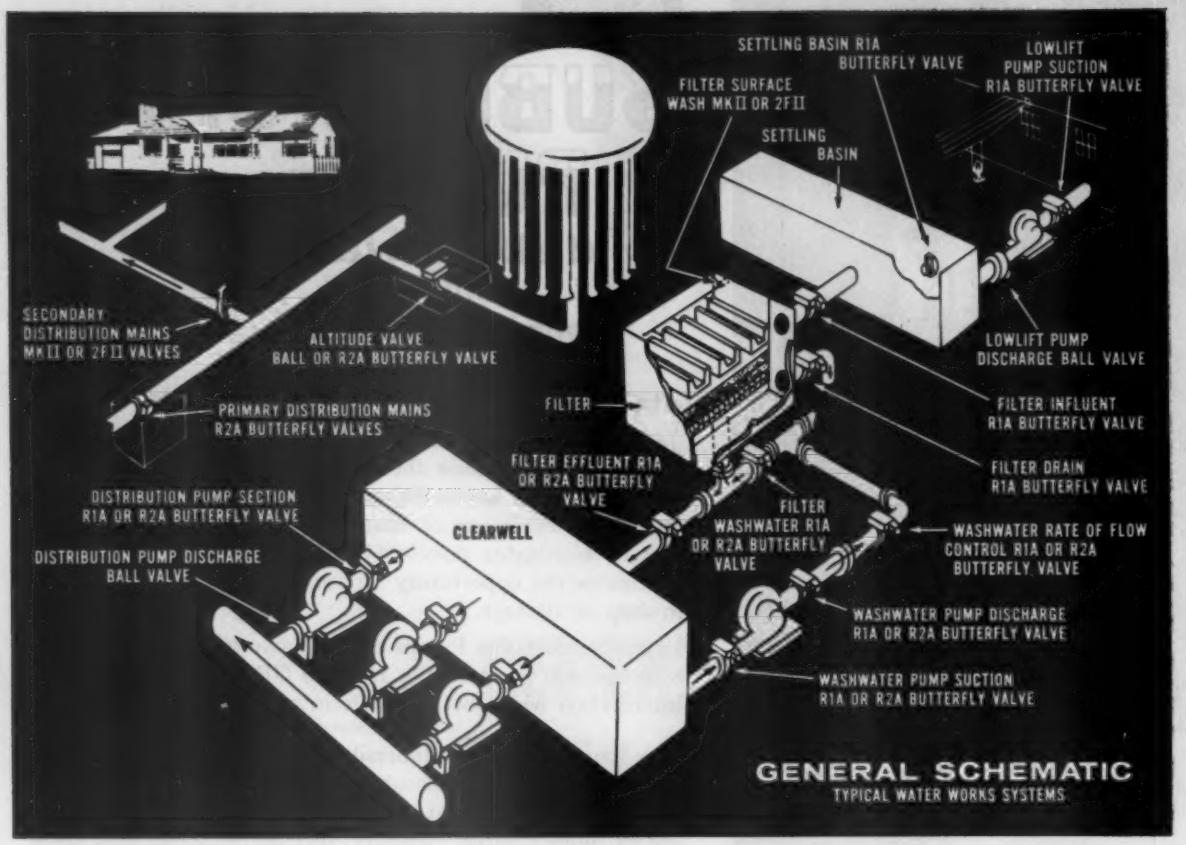
**LAYNE & BOWLER, INC., MEMPHIS**

*General Offices and Factory, Memphis 8, Tenn.*

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Sales Representatives in Major Cities

Find LAYNE Fast in the Yellow Pages under pumps


SETTLING BASIN R1A BUTTERFLY VALVE
LOWLIFT PUMP SUCTION R1A BUTTERFLY VALVE
FILTER SURFACE WASH MKII OR 2FII
SETTLING BASIN
SECONDARY DISTRIBUTION MAINS MKII OR 2FII VALVES
ALTITUDE VALVE BALL OR R2A BUTTERFLY VALVE
LOWLIFT PUMP DISCHARGE BALL VALVE
PRIMARY DISTRIBUTION MAINS R2A BUTTERFLY VALVES
FILTER
FILTER INFLUENT R1A BUTTERFLY VALVE
FILTER EFFLUENT R1A OR R2A BUTTERFLY VALVE
FILTER DRAIN R1A BUTTERFLY VALVE
DISTRIBUTION PUMP SECTION R1A OR R2A BUTTERFLY VALVE
CLEARWELL
FILTER WASHWATER R1A OR R2A BUTTERFLY VALVE
WASHWATER RATE OF FLOW CONTROL R1A OR R2A BUTTERFLY VALVE
DISTRIBUTION PUMP DISCHARGE BALL VALVE
WASHWATER PUMP DISCHARGE R1A OR R2A BUTTERFLY VALVE
WASHWATER PUMP SUCTION R1A OR R2A BUTTERFLY VALVE
GENERAL SCHEMATIC
TYPICAL WATER WORKS SYSTEMS

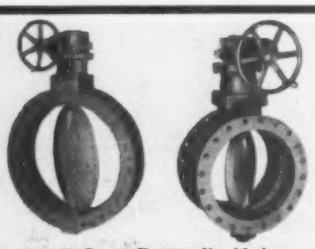

## *Now you can use Henry Pratt top quality valves...*

# FROM SOURCE TO HOUSE

For thirty years Henry Pratt Rubber Seated Valves have been famous as the most reliable valves for controlling large volumes of water.

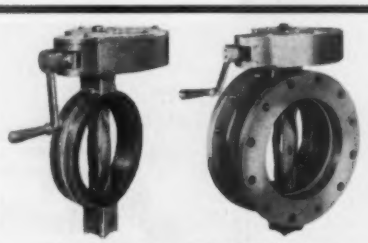
The complete line shown below can provide service throughout the entire waterworks system.

Each valve is carefully engineered to have the same Henry Pratt qualities—complete dependability, economy and long life without maintenance. On your next project, consult a Henry Pratt engineer—and get the *complete* rubber seat valve story.



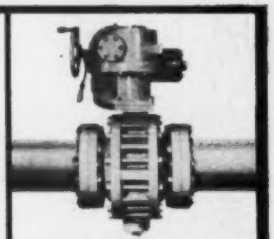
**Anvil Seat Butterfly Valves**

For 25-8 thru 50-16 in narrow face-to-face and 50-8 thru 125-16 in wide face-to-face, 24" and up Thoroughly proven in filter plant, pump discharge and distribution service under maximum pressures and velocities. Seat is adjustable and replaceable for bubble tight service in any size. **Catalog B-3B**



**Monoflange and 2FII Valves**

For pressures to 150 pounds, ideal for small plants or secondary distribution. In sizes from 3" through 20". Monoflange is "wafer" type with rubber seat acting as gasket. 2FII is flanged model. Complete range of operators. Structurally A.W.W.A. 125-16. **Catalog B-11B**



**Ball Valve**

The first proven rubber seated ball valve is ideal for pump check service or high pressure distribution. Features new Pratt Rolo-Link cylinder operator. **Catalog BA-1B**

HENRY PRATT®

**Creative Engineering for Fluid Systems**

**HENRY PRATT COMPANY**
319 W. Van Buren Street, Chicago 7, Illinois
*Representatives in Principal Cities*

# 95% SPACE SAVINGS for sewage plants

COMPARATIVE SPACE REQUIREMENTS
(Based on data in FISWA Manual of Practice No. 8, 1959)

| Population | Average area for open sand beds (square feet) | Average area for complete vacuum filter installation (square feet) |
|---|---|---|
| 10,000 | 17,500 | 950 |
| 20,000 | 35,000 | 1,400 |
| 30,000 | 52,000 | 1,900 |
| 40,000 | 70,000 | 2,250 |
| 50,000 | 87,500 | 2,650 |
| 100,000 | 175,000 | 3,500 |

**Vacuum filters using Pennsalt Ferric Chloride** to get faster coagulation—and denser, drier filter cake—require as little as 5% of the area of open sand beds. And labor costs are lower . . . odor problems eliminated . . . peak loads more readily handled.

Plan to use this modern method of filtration in your new plant. We will be glad to share with you and your consulting engineers our 30 years of experience with ferric chloride. Write Industrial Chemicals Division, PENNSALT CHEMICALS CORPORATION, Three Penn Center, Phila. 2, Pa., 2901 Taylor Way, Tacoma 2, Wash.

**For dependable water treatment,** use Pennsalt Water Works Grade Chlorine.

*See our complete listing in Chemical Materials Catalog*

**Industrial Chemicals Division**

SALES OFFICES: APPLETON • ATLANTA • CHICAGO • DETROIT
LOS ANGELES • NEW YORK • PHILADELPHIA • PITTSBURGH
PORTLAND • ST. LOUIS • SAN FRANCISCO • TACOMA

FOREIGN SALES: INDUSTRIAL QUÍMICA PENNSALT, MEXICO CITY
PENNSALT INTERNATIONAL, PHILADELPHIA, PA.

**Pennsalt Chemicals**
ESTABLISHED 1850

*OLD FIRE HYDRANTS*

# STILL DOING 24-HOUR DUTY

*IN CAMDEN, N.J.*

The Camden, N.J., Water Department was formed in 1845, when James K. Polk was president. A small building was erected at the foot of Cooper Street to house the pumping station. Water mains were installed and approximately 15 years later, R. D. Wood Hydrants were tied in. Since those days Camden has grown from a community of 6500 people to a modern industrial city of 125,000. All utilities have been changed beyond recognition . . . except for a number of the original R. D. Wood Hydrants that are still in service. Conditions have changed, but the reliability built into those hydrants makes them just as effective now as they were over 100 years ago.

Like all R. D. Wood Hydrants, the oldtimers are of simple but sound construction; their operation cannot be impaired by foul weather, snow, sleet, ice or silt. Apart from the hazard of being in the path of a truck out of control or the possibility of street relocations, there is no foreseeable trouble ahead for them for many more years. There has never been better fire protection for any community than R. D. Wood Hydrants.

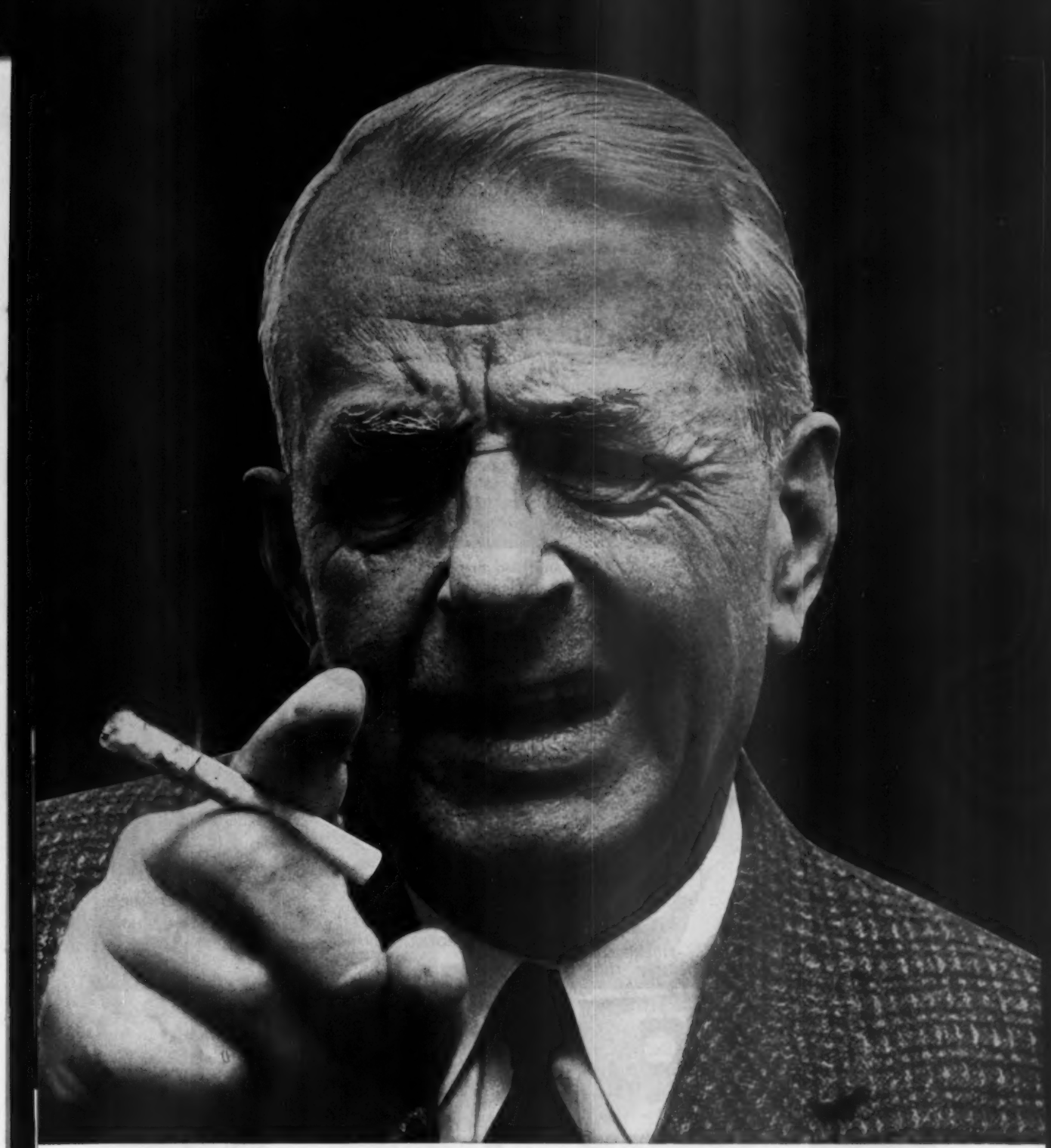
**Conform to A.W.W.A. specifications**

**R. D. WOOD COMPANY**

**FLORENCE**
**NEW JERSEY**

***Established in 1803***

**Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds)**



# "I oughta wring that pump salesman's neck!"

"They're shipping next week, he says . . . but I've heard *that* old line for six weeks! Sure, my pump's a 'special', but *he* oughta know how long it takes to build one. We've geared all our plans to his phoney promise, and now the Mayor's raising the roof! After this, we'll stick with outfits who've got enough 'big-pump' savvy to *deliver on time!*"

The ability to deliver on time is another of the extra values you get when you deal with Allis-Chalmers. Industrial Equipment Division, **Allis-Chalmers,** Milwaukee 1, Wisconsin. A-1510

**ALLIS-CHALMERS DELIVERS ON TIME**

At Allis-Chalmers we have accepted penalty clause contracts because we know that in 99% of the cases we can deliver. That 99% is an actual fact, based on many years of experience in supplying pumps to municipalities. We have the resources and the manufacturing facilities to get pumps delivered when promised.

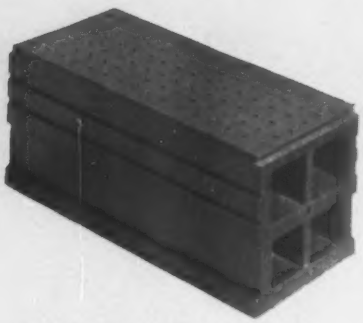
# Leopold....

**ONE SOURCE, ONE RESPONSIBILITY**

# WATER PURIFICATION AND FILTER PLANT EQUIPMENT

For more than forty years, Leopold has been serving municipalities with time-tested products, technical "know-how" and filter plant design experience. Now you can specify Leopold for the entire job, whether it be for rebuilding or adding plant capacity. Depend on Leopold's careful handling to produce an effectively engineered operation complete with dependable Leopold products, from "top to bottoms." Write for complete information on any of the products illustrated to the F. B. Leopold Company, Inc., 227 South Division Street, Zelienople, Pennsylvania.

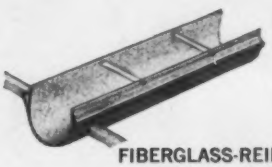
Leopold also manufactures flash and vertical shaft paddle mixers, samplers and sampler tables, orifice box solution feeders and other accessories.



GLAZED TILE FILTER BOTTOMS

RUBBER-SEATED BUTTERFLY VALVES

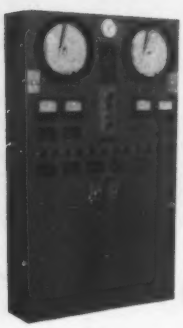
FIBERGLASS HOPPERS AND SOLUTION CHAMBERS



FIBERGLASS-REINFORCED PLASTIC WASH TROUGHS

ROTARY SURFACE WASHERS

DRY CHEMICAL FEED MACHINES



FILTER OPERATING TABLES AND PANELS

Leopold

**F. B. LEOPOLD CO., INC.**

**Zelienople, Pa.**

your customers
test your water daily
*So should you!*

AQUA
NUCHAR
ACTIVATED
CARBON
*for taste and odor control*

Even your best friends will tell you . . . *fast* . . . when your water tastes or smells bad.

Best way to forestall complaints is with daily threshold odor tests to detect and accurately measure variations, then using AQUA NUCHAR in controlled amounts to meet these changing day-to-day needs thereby assuring *consistent palatability.*

AQUA NUCHAR adsorbs tastes and odors due to algae, decaying vegetation, trade wastes and other causes. Where adequate feed capacity is available, it is the only method proved universally effective. And it is economical, too, since only a few ppm average concentrations do an effective job.

Our field technical staff is available to survey your plant and advise on your requirements.

**West Virginia Pulp and Paper**
INDUSTRIAL CHEMICAL SALES DIVISION

230 Park Ave., New York 17 · Philadelphia National Bank Bldg., Philadelphia 7 · 35 E. Wacker Dr., Chicago 1 · 2775 S. Moreland Blvd., Cleveland 20

MEMORIAL VILLAGE WATER SUPPLY CORPORATION, Houston, Texas wanted self-priming sewage pumps, installed high and dry for low cost and easy access in service . . .

# ANOTHER MODERN SEWAGE TREATMENT PLANT INSTALLS GORMAN-RUPP HIGH-AND-DRY PUMPS

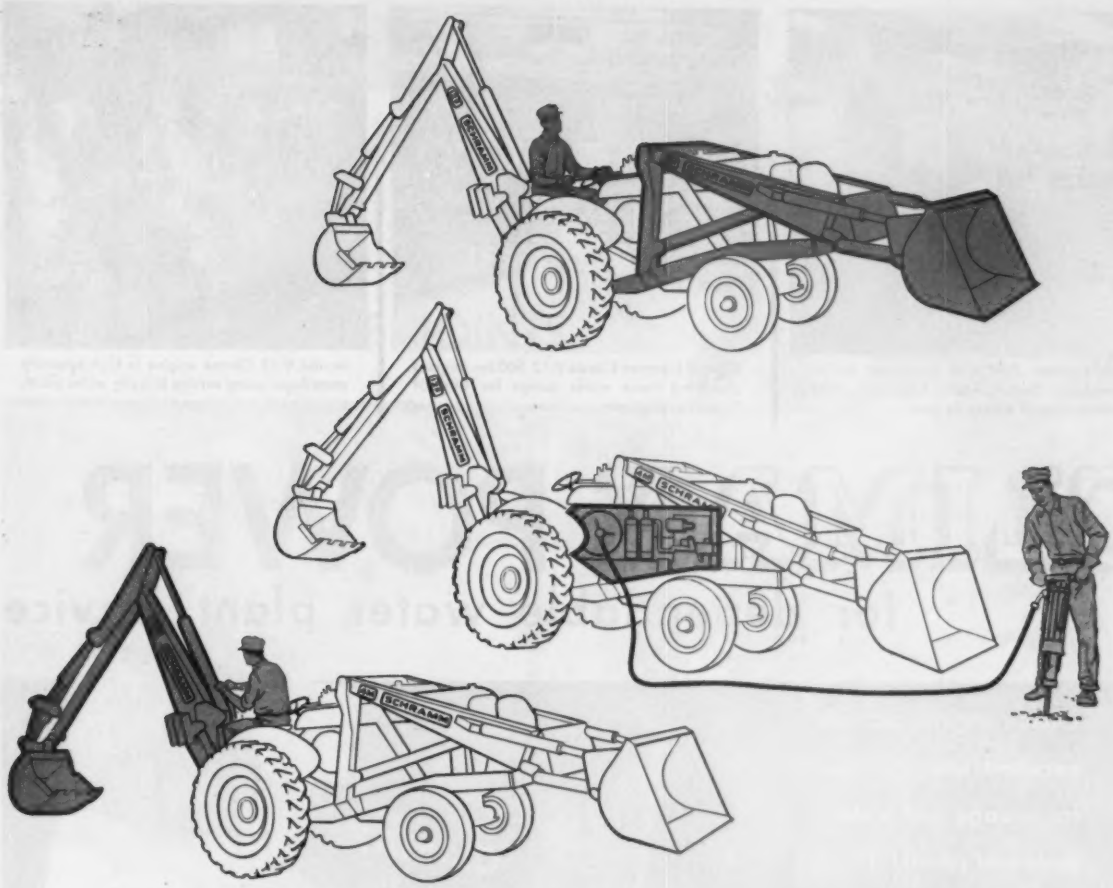
This electronically-controlled Texas plant includes 4″ and 6″ Gorman-Rupp sewage pumps, Models 14A2 and 16A2 respectively.

They are self-priming. They handle solids, up to 2½″ in the 6″ pump. They have quick-removable endplates for fast, easy cleanout. They're installed high-and-dry, not down in a pit, for low first cost and easy service. And they're built for dependably continuous operation and rock-bottom maintenance costs.

Advantages like these are perfect for the highly modern Memorial Village sewage plant. As illustrated, the pumps are driven by wound-rotor electric motors. Operating speed is governed by electronic-sensing, flow-matching controls. The 4″ pump operates from 1900 rpm down to 1100 rpm, and the 6″ pump from 1200 to 600 rpm. Operating rates vary from 1800 to 50 gpm, controlled entirely by the rate of incoming sewage. Heat exchangers on suction pipes keep liquid in the flow-matchers at controlled temperatures.

Just remember—in *any* sewage treatment plant—Gorman-Rupp pumps give you maximum on-the-line dependability at minimum overall cost. *See your authorized distributor or write us direct.* 3213

**THE GORMAN-RUPP COMPANY**
305 BOWMAN STREET MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LTD., ST. THOMAS, ONTARIO



## Co-ordinate your Air Power with the SCHRAMM

# new

## Series 62 *Pneumatractor*
## Model 12F Backhoe
## Model 4M Loader

Here is a new multi-purpose piece of equipment that will co-ordinate every task on your construction job. The new "Series 62" Heavy Pneumatractor is a self-propelled 125 cfm air compressor . . . a powerful 42 hp tractor . . . a heavy-duty backhoe . . . and a hard-working loader . . . *all in a single package.* The "Series 62" will do all four jobs *and costs far less than four separate units to do the same work.*

Check these new "Series 62" features:

**"Controlled Air Delivery"** . . . select air power you need, from 42 to 125 cfm, to break out paving, drill rock, tamp backfill . . . even while using loader or backhoe.

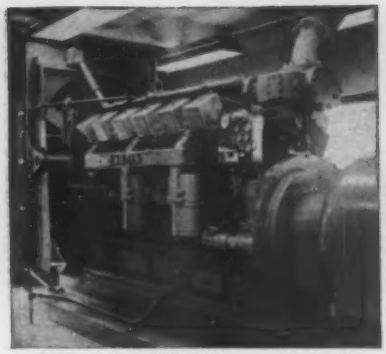
**Independently-mounted frame** . . . new, sturdy box steel frame for mounting accessories relieves crankcase, clutch and transmission from all stress and strain.

**Model 12F Backhoe** . . . heavy-duty box steel construction of completely-new design . . . digs to 12'8" . . . hydraulically operated.

**Model 4M Loader** . . . 4,000 lb. capacity . . . longer, higher reach . . . fully hydraulic . . . box steel for strength.

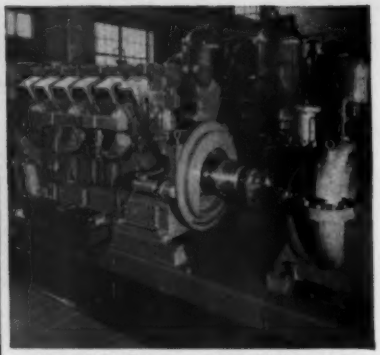
Many other new features bring you an "all-round" machine in a single package to save you initial investment, operating costs and maintenance expense. *For full details including the many accessories available write Schramm, Inc., 76 Garfield Ave., West Chester, Pa.*

PART OF A
**SCHRAMM**
CO-ORDINATED AIR POWER
PACKAGE



Climax-driven 250 KW generator in St. Petersburg, Florida, water treatment plant protects against power failure.

Eight of fourteen Climax V-12 500 hp. engines powering storm water pumps for City of Saginaw, Michigan.



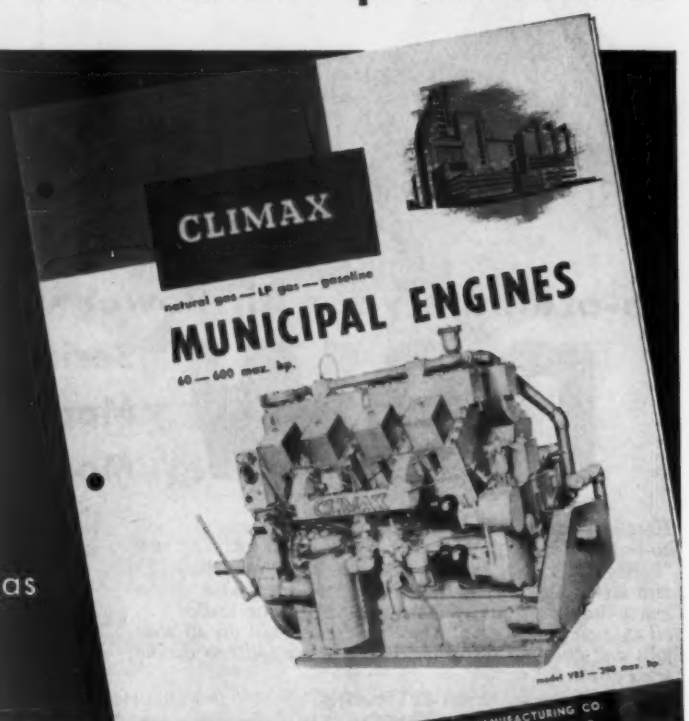
Model V-12 Climax engine in high capacity centrifugal pump service in a city water plant.

# CLIMAX POWER

## for dependable water plant service

Climax engines provide excellent low cost power for sewage and water treatment plants. These rugged, simply designed engines are engineered to give quick acceleration, withstand overloading, and perform longer with less maintenance.

natural or sewage gas
LP gas • gasoline
60 to 600 max. hp.




| BASIC MAX. ENGINE HP (Natural Gas and Gasoline) ① | | | | | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MODEL | No. of Cyls. | Bore & Stroke | Displ. | Torque @ RPM | BRAKE HORSEPOWER AT SPEEDS INDICATED | | | | | | |
| R-165 | 6 | 6⅛ x 7 | 1238 | 930 @ 750 | 105 | 123 | 140 | 156 | 170 | 183 | 192 |
| K-67 | 6 | 7 x 7 | 1616 | 1240 @ 805 | 140 | 165 | 188 | 210 | 230 | 248 | 265 |
| K-75 | 6 | 7½ x 7 | 1855 | 1410 @ 800 | 160 | 186 | 214 | 240 | 265 | 286 | 304 |
| V-80 | 8 | 7 x 7 | 2155 | 1610 @ 850 | 178 | 210 | 241 | 272 | 300 | 323 | 340 |
| V-85 | 8 | 7½ x 7 | 2474 | 1860 @ 900 | 207 | 249 | 285 | 317 | 345 | 370 | 390 |
| V-122 | 12 | 7 x 7 | 3232 | 2440 @ 900 | 280 | 330 | 380 | 420 | 460 | 490 | 520 |
| V-125 | 12 | 7½ x 7 | 3711 | 2880 @ 850 | 310 | 370 | 435 | 490 | 540 | 580 | 605 |

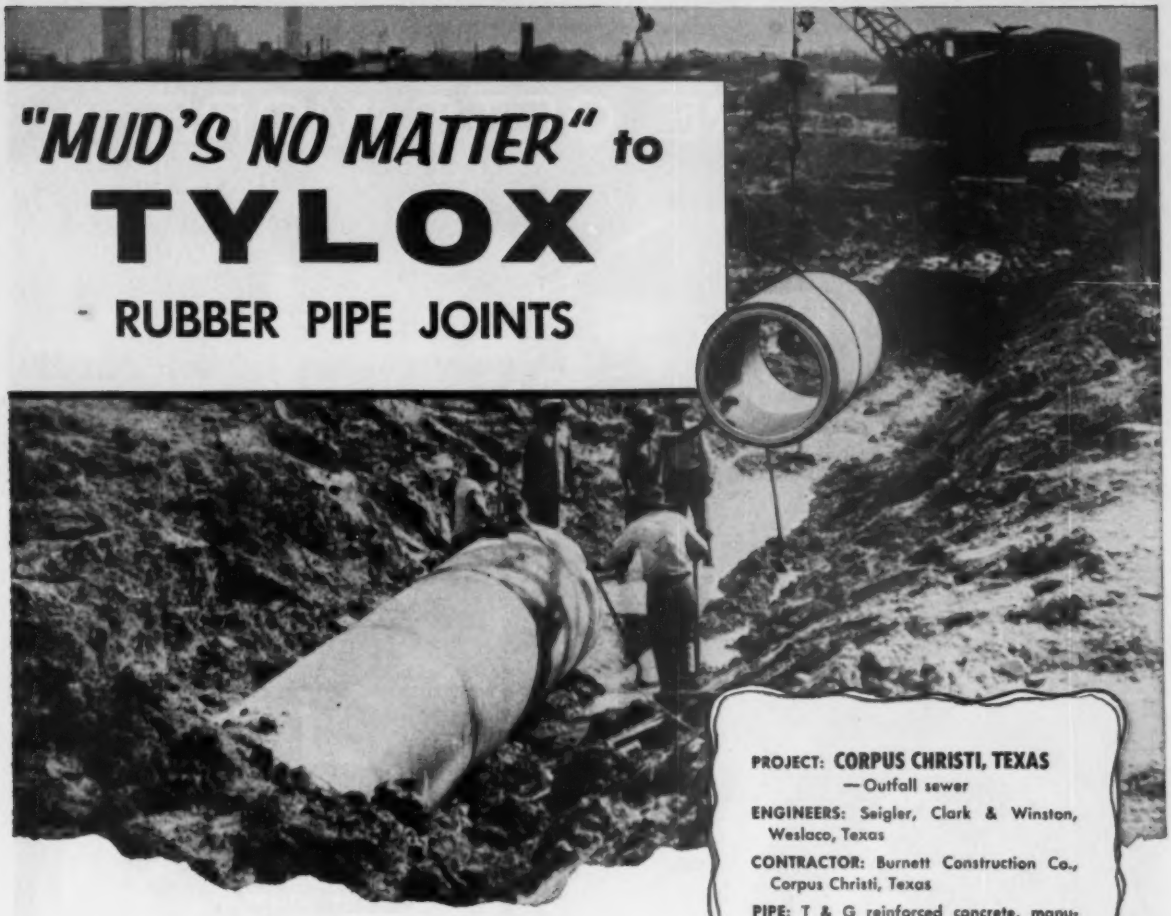
① Basic engine includes ignition, maximum carburetion, and water pump. Ratings indicate maximum horsepower.

CLIMAX ENGINE MANUFACTURING CO. • FACTORY—CLINTON, IOWA
DIVISION OF WAUKESHA MOTOR COMPANY

send for
BULLETIN
SA-631

CL-121

# "MUD'S NO MATTER" to TYLOX - RUBBER PIPE JOINTS



**PROJECT: CORPUS CHRISTI, TEXAS**
— Outfall sewer

**ENGINEERS:** Seigler, Clark & Winston, Weslaco, Texas

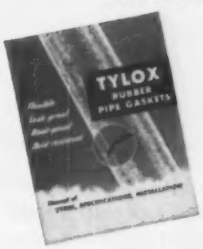
**CONTRACTOR:** Burnett Construction Co., Corpus Christi, Texas

**PIPE:** T & G reinforced concrete, manufactured by TEXCRETE Company, Corpus Christi, Texas

MUD . . . as shown in the photo, was the prevailing condition on this outfall sewer project in Corpus Christi, Texas. Yet the "mucky" conditions did not slow up installation of the TYLOX-coupled 42" concrete pipe. The line was laid and backfilled as rapidly as the cranes could work, and the joints were *water-tight!*

In specifying TYLOX RUBBER GASKETS, engineers and officials knew they could count on faster pipe coupling to help reduce pipe installation costs, *whatever* the conditions might be. But that's not all . . . in specifying TYLOX they took advantage of a coupling material known also for its ability to make pipe joints leakproof and root-proof for the life of the pipe itself.

**WRITE FOR NEW TYLOX BROCHURE**




It contains engineering data and fully illustrated case histories showing why TYLOX Rubber Gaskets are specified the world over to assure the economy, safety and longevity of sewerage and drainage pipe lines.

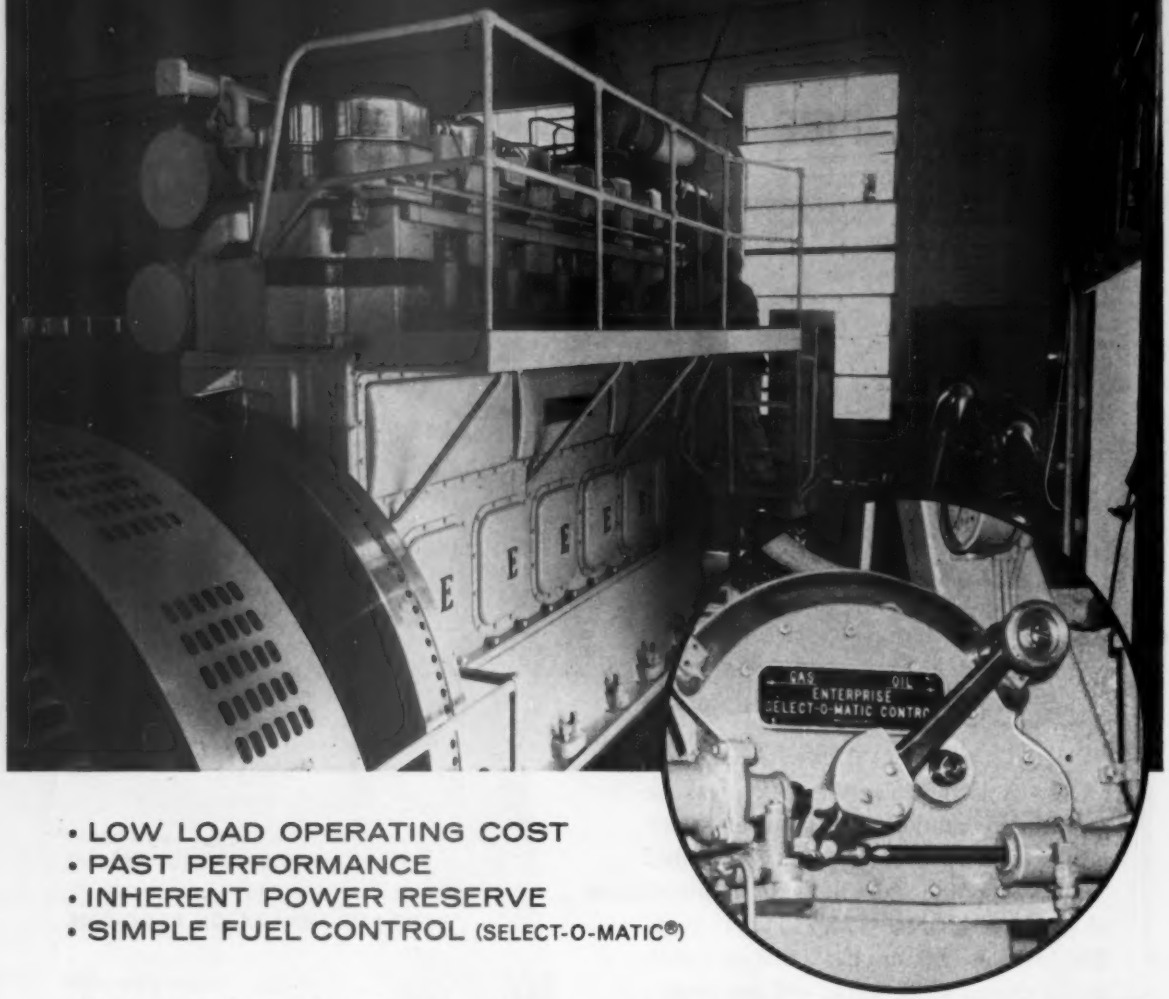
**HAMILTON KENT MANUFACTURING COMPANY**

KENT, OHIO

427 West Grant St. ORchard 3-9555

5068

# WITH ENTERPRISE *TRI-FUEL* ENGINE
# JETMORE GETS MORE




- LOW LOAD OPERATING COST
- PAST PERFORMANCE
- INHERENT POWER RESERVE
- SIMPLE FUEL CONTROL (SELECT-O-MATIC®)

Jetmore, Kansas, selected another *heavy duty ENTERPRISE* Engine based on ten years experience.

"Because we have such a wide variation in loads and operate at a load factor of only 45 per cent," said Emery C. Graves, Utilities Superintendent, "we decided on a Tri-Fuel Enterprise. From our past experience we found that the exceptionally low cost of operating an Enterprise at such a low load factor is outstanding."

Operating at a cost of only 3.55 mils per KWH, based on lube oil cost of 70¢ per gallon and natural gas at 22½¢ per MCF, the City of Jetmore's new Enterprise produces 12,570 KWH per gallon of fuel.

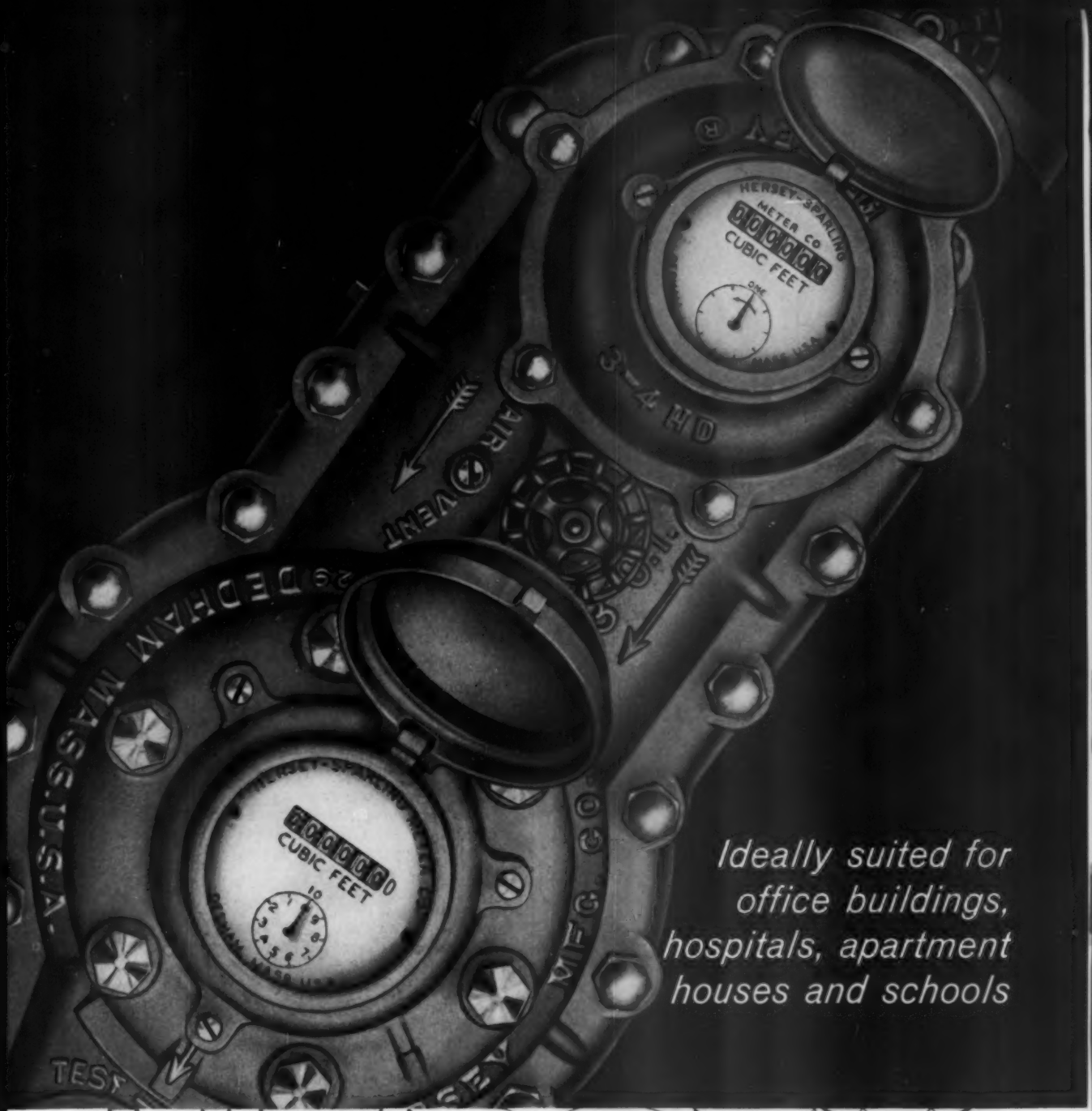
There's an economical, *heavy duty ENTERPRISE* Engine for every municipal, co-op or industrial use – for electric power generation, sewage plant power, pumping systems – from 73 to 7703 HP. Available in diesel, dual fuel, tri-fuel or spark ignited gas. Call or write today for full information.

**ENTERPRISE Engines**

*Power Division of General Metals Corporation*

A SUBSIDIARY OF TRANSAMERICA CORPORATION

*550 85TH AVE., OAKLAND 21, CALIF. • 37-02 48TH AVE., LONG ISLAND CITY 1, N.Y. — National and worldwide sales and service*




*Ideally suited for office buildings, hospitals, apartment houses and schools*

# HERSEY

## Compound Meter (MODEL CT—SINGLE BRONZE CASE)

One of these registers measures *low* rates of flow. The other measures *high* rates of flow. They combine in the Hersey Compound Meter to give you accurate measurement of a wider range of flows than can be recorded by any single register. Bronze case: 2″, 3″, 4″, 6″ sizes. Iron Cases: 8″, 10″ sizes.

Hersey-Sparling
*Meter Company*
HERSEY PRODUCTS
DEDHAM, MASSACHUSETTS

*Branches: Atlanta, Boston, Chicago, Cleveland, Dallas, Denver, Kansas City, Mo., Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle.*

# Meetings

WHAT WHEN WHERE

## 1961

| OCTOBER | | | | | | | NOVEMBER | | | | | | | DECEMBER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | | 1 | 2 | 3 | 4 | | | | | | 1 | 2 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 29 | 30 | 31 | | | | | 26 | 27 | 28 | 29 | 30 | | | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| | | | | | | | | | | | | | | 31 | | | | | | |

Nov. 15-16—Indianapolis, Ind. (*Hotel Washington*) INDIANA SECTION SEWAGE & INDUSTRIAL WASTES ASSN. Secy., Victor G. Wagner, State Dept. of Health, 1330 W. Michigan St., Indianapolis 7, Ind.

Nov. 27-Dec. 1—Stillwater, Oklahoma (*Oklahoma State University*) OKLAHOMA WATER, SEWAGE & INDUSTRIAL WASTES CONF. Secy., M. H. Crane, 3400 Northeastern, Oklahoma City 5, Okla.

Nov. 27-Dec. 1—New York, N. Y. (*Coliseum*) 28th EXPOSITION OF CHEMICAL INDUSTRIES.

Dec. 3-6—New York, N. Y.—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Includes Symposium on Water Pollution.

Dec. 4-15—Cincinnati, Ohio (*Robert A. Taft Sanitary Engineering Center*) Training Course: Chemical Analyses For Water Quality. Write: Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, or to a PHS Regional Office.

Dec. 11-15—University Park, Pa. (*The Pennsylvania State University*) Short Course: Sewage Works Operators. Write: Conference Center, the Pa. State University, University Park, Pa.

## 1962

Jan. 15-16—Cincinnati, Ohio (*Robert A. Taft Sanitary Engineering Center*) Short Course: "Basic Radiological Health." This course will be repeated at the Sanitary Engineering Center Apr. 23-May 4; at Southwestern Radiological Health Laboratory, Las Vegas, Nevada, Feb. 26-Mar. 9; and at Radiological Health Laboratory, Rockville, Maryland, May 7-18. Write: Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, or to PHS Regional Office.

Jan. 23—New York, N. Y. (*Statler-Hilton Hotel*) NEW YORK SECTION AWWA Luncheon Meeting. Secy., Kimball Blanchard, Neptune Meter Co., 2222 Jackson Ave., Long Island City.

Feb. 4-7—Los Angeles, Calif. AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Includes Symposia on Air Pollution; Ion Exchange; Water Desalinization.

Feb. 5-9—Cincinnati, Ohio (*Robert A. Taft Sanitary Engineering Center*) Short Course: "Recent Developments in Water Bacteriology." Sponsored by Public Health Service. Write: Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, or to PHS Regional Office.

CONTINUED ON PAGE 86A

One of the EDDY flush type hydrants being installed at Dulles International Airport, Washington. At the right is artist's drawing of fabulous new terminal building.

# "Gateway to America" installs EDDY Hydrants and Valves

## to serve new jet-age airport

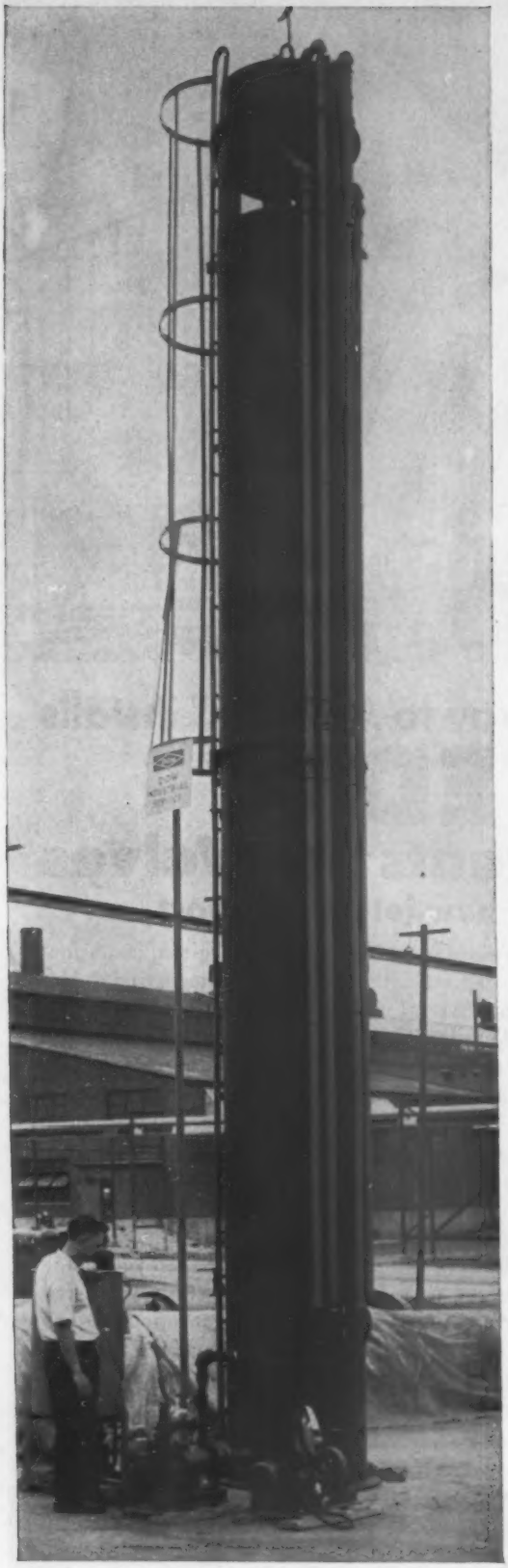
A jet-age showplace is taking shape in Virginia, just a few miles from the capital...the new Dulles International Airport, which the Federal Aviation Agency has called the "Gateway to America."

Material for every facility at this multi-million dollar airport has been selected with the utmost care and meets federal specifications. The choice of EDDY hydrants and valves for controls in this all-important waterworks and fire protection system is a tribute to the precise, long-life performance of these products.

EDDY valves and hydrants have provided uninterrupted service in hundreds of communities for 40, 60, 80 years and longer. Yet, the certainty of continuous availability of replacement parts assures that an EDDY-equipped waterworks system is always up-to-date. EDDY valves and hydrants meet all AWWA standards and are available to fit any existing or planned installation.

***SEND TODAY** for information on the complete line of EDDY Valves, Hydrants and other waterworks specialties*

**EDDY VALVE COMPANY**
A Subsidiary of James B. Clow & Sons, Inc.
**WATERFORD NEW YORK**



Pilot plants are 28' high, 3' in diameter. They come completely assembled, with nutrient feeder, pumps and other equipment ready for connection and immediate use.

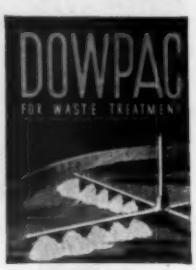
# LOW-COST PILOT PLANT USING NEW DOW DEVELOPMENT CAN HELP SOLVE YOUR WASTE TREATMENT PROBLEMS!

Now, at little cost, you can install a trickling filter pilot plant using new Dowpac® biological oxidation media. This research tool will show you precisely how you can treat wastes efficiently . . . and how best to do it . . . under *your actual operating conditions.* Data obtained from pilot plants can be used for later scaling-up to full size—but compact—installations.

D.I.S. will lease or sell pilot plants, as you wish. D.I.S. engineers will assist in installing the plant, put it in operation for you, and interpret collected data to work out the most effective treatment for your particular problem.

Dowpac provides conditions approaching the design ideal for trickling filter-type systems, including light weight, to permit land-saving vertical construction . . . tremendous surface area for maximum bacteria growth . . . minimum of plugging or channeling . . . and practically no maintenance.

**Write for new booklet** on Dowpac, and for information on low-cost pilot plants. D.I.S. engineers will be glad to work with you to develop the most effective method for water and waste treatment for your particular conditions. Write DOW INDUSTRIAL SERVICE, 20575 Center Ridge Road, Cleveland 16, Ohio, Dept. W&SW11.

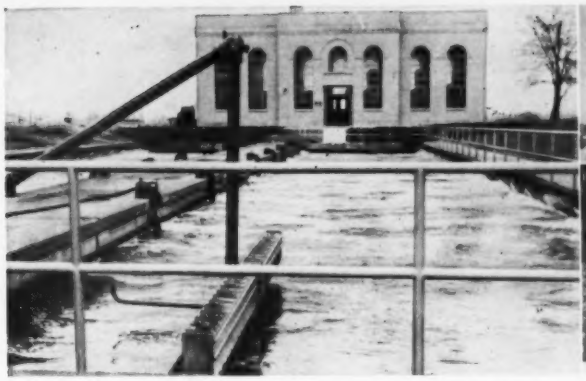



Dowpac is a trademark for packing media—not pilot plants.

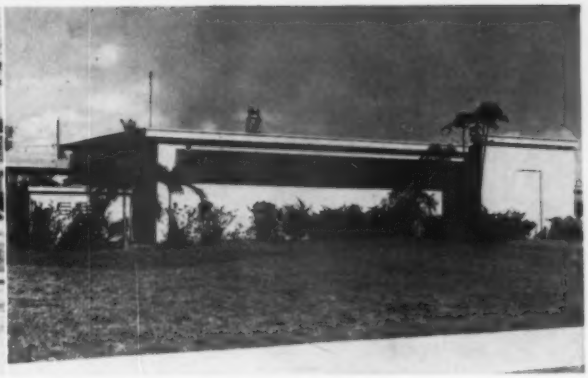
DOW

**DOW INDUSTRIAL SERVICE**

Division of The Dow Chemical Company



**Swing Diffuser® Aeration Equipment** with SHEARFUSER Diffusers provide clog-proof, highest oxygenation and circulation at lowest air pumpage and power use. Bulletin 175A.



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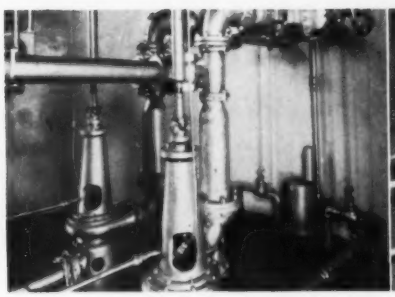

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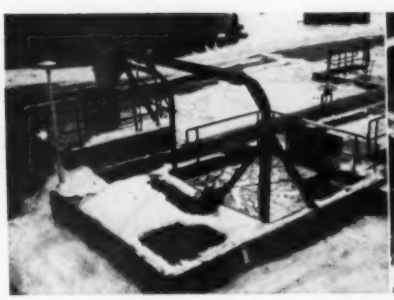

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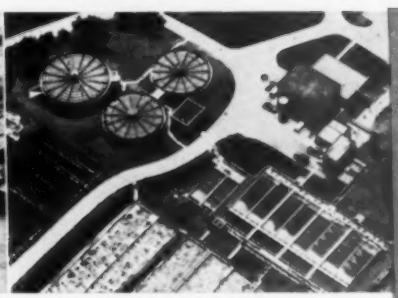

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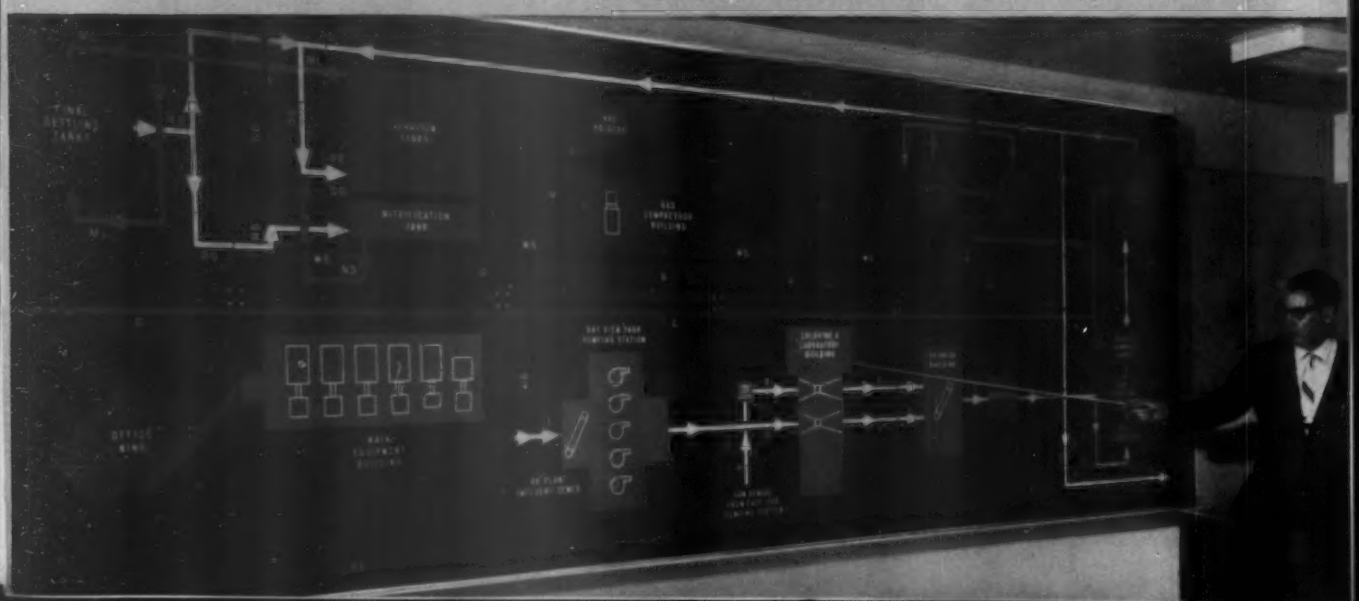

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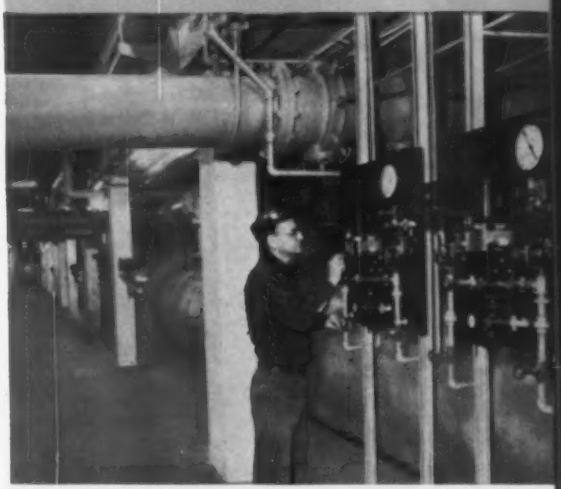
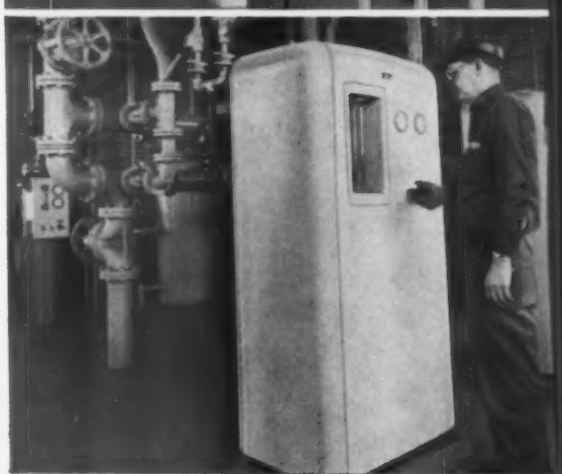
So that's the Toledo Sewage Plant story—and here's the moral: On your next control system, contact Fischer & Porter—where you get true unified responsibility from design through operation. For our over-all story in brief, write for a copy of Catalog 310. For a discussion of your specific control problem, call your nearest F&P field engineer. Fischer & Porter Company, 211 Fischer Road, Warminster, Pa. In Canada: write Fischer & Porter (Canada) Ltd., 2808 Jane Street, Toronto.

In the tunnel under the tanks, where most of the various flows are measured. Each local panel contains a Fischer & Porter dp transmitter, square root-to-linear signal pneumatic relay, indicating flow gauge and meter manifold. Values of these flows are also transmitted to the central panel for recording and totalizing.





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Vol. 108, No. 11 • November 1961
WATER & SEWAGE WORKS
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Studies in Maine and New Hampshire deal with . . .

# Natural Radioactivity In Ground Water - Part 1

by WERNER N. GRUNE, Project Director
Professor of Sanitary Engineering
School of Civil Engineering
Georgia Institute of Technology
Atlanta, Georgia

■ FIRST OBSERVED in certain minerals, radioactivity has since been found to be associated with practically all minerals, rocks, natural waters and to some extent in the atmosphere surrounding man. Health departments throughout the nation are becoming more cognizant of the various aspects of ionizing radiation and for the need to develop new information, better laboratory methods, monitoring man-made radiation and to measure the total ionizing radiation dose to which man is exposed. The U.S. Public Health Service has been willing to assume leadership for studies in many areas of the United States. Many health problems cut across state and local boundaries, or are beyond the normal resources of the individual states and communities. The Public Health Service helps the states to deal with such problems, which are nowhere more pressing today than in the field of radiological health.

## History

Ionizing radiation was here long before life began on earth. Yet it was not until 1895 that Roentgen discovered X-rays, which was followed in 1896 by Becquerel's discovery of natural radioactivity. Thus the time spent from the discovery of radioactivity to the present is less than one lifetime. The concept that this newly discovered form of energy requires careful surveillance and control is still younger. Up to 1954 peaceful as well as military uses of atomic energy materials were developed principally under federal contracts, which meant that health and safety control was imposed directly through federal contract administration. The Atomic Energy Act of 1954 changed this situation radically insofar as the emerging atomic energy industry was no longer contained by a tight government monopoly. Along with the steadily increasing use and breadth of application of nuclear materials by industry, there has been a growing demand for more comprehensive radiological health programs in the established public health agencies.

The Second United Nations' International Conference on the Peaceful Uses of Atomic Energy held in Geneva in September, 1959, pointed out that by 1970 nuclear power stations will have a capacity of at least fifty times that of 1958. The development of the U.S. nuclear-power industry from 1965 to 1995 is expressed by an estimated increase from $1.5 \times 10^4$ to $5.5 \times 10^5$ megawatts of power capacity, accompanied by an increase from $1.5 \times 10^6$ to $2 \times 10^9$ gal daily of high and intermediate level waste products[1].

## New Department

The increasing awareness of the problems of ionizing radiation led Congress to the creation, of a new Division of Radiological Health within the Bureau of State Services. During August, 1959, the President issued Executive Orders for the establishment of the Federal Radiation Council, and directing an intensified radiological health effort for the "collation, analysis and interpretation of data on environmental radiation levels, such as natural background radiography, medical and industrial use of isotopes and X-rays and fallout". The attack on this great problem was divided into fourteen specific responsibilities, which can be grouped into six major areas:

1. Research on the effects of radiation on living matter, including man;

2. Development of methods, facilities and programs for collecting, collating, analyzing and interpreting data on all forms of radiation exposure throughout the United States;

3. Training of the scientific, professional and technical workers needed in the rapidly expanding radiological health programs of the Federal, State and local agencies;

4. Technical assistance to Federal, State and local agencies, as needed;

5. Development of recommendations for acceptable levels of radiation exposure from air, water, milk, medical procedures and the general environment; and

6. Public information and health education activities related to radiological health.

As a result of the recognition of these responsibilities the Division of Radiological Health has expanded existing programs of environmental monitoring and training, and initiated new projects in radio-epidemiological research. As one of the studies which are under way, natural background radiation in the northeastern United States, the investigations herein reported played a significant part.

## Radioactive Water

Early in 1958 radioactivity in a private well water supply was discovered

in Maine. This particular well had been in use for about eight years. Samples from this well were analyzed by the State Health Department of Maine, the Public Health Service, Sanitary Engineering Center, Cincinnati, Ohio, and the Public Health Occupational Health Field Station at Salt Lake City. Results of analyses indicated a dissolved radium concentration of 64 $\mu\mu$gm/l and a total uranium concentration of 860 $\mu$gm/l. The radon content was much higher. Following these analyses, the State Health Department of Maine advised the Dielectric Products Corp., at Raymond to discontinue the use of the water for human consumption.

Starting in April, 1958, a larger number of wells in the Raymond area were analyzed for natural radioactivity by the Public Health Service. Significant amounts of radon and daughter products were found in all wells, and a more detailed analysis of the problem seemed indicated.

Approximately 1,000 residents, with twice as large a number of transients during the summer, were using this water. People had been using this water for more than eight years, and steps were taken by the State Health Department to advise all residents to discontinue the use for human ingestion of water from wells with high activity.

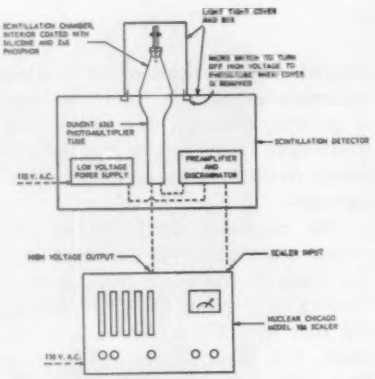
### Studies Follow

To implement the public health approach for the control and/or reduction of exposure to radiation from ground waters in this area, the studies herein described were undertaken. These studies include the development of a simple, reliable and reproducible field method and equipment for the analysis and detection of certain of the naturally occurring radioisotopes in water, radiochemical analyses for the daughter products; gross and isotopic counting procedures and suggested methods to reduce or remove the radioactivity from the water supplies.

The Georgia Institute of Technology Sanitary Engineering Laboratories were requested by the Division of Radiological Health to conduct an investigation of natural radioactivity in water based on the discoveries in Maine and New Hampshire. The results of this study were submitted in February, 1960 as a complete scientific report[2]. Since the completion of the field survey, efforts have been directed toward the development of improved detection equipment and refinements in analytical techniques.

## Development Of Improved Detection Equipment

As a part of the program for improved detection equipment, it was decided to develop a special type of combined scaler-scintillator detection system which was to embody the following features: 1. the unit should be housed in one cabinet, 2. the unit should be hand portable, 3. the unit should be operable from either batteries or from 110v AC. (The original unit is shown in Figure 1). It was also decided that the unit should be completely transistorized to reduce weight, bulk and power requirements. Another desirable feature was to incorporate a separate chamber for planchet counting. This detection equipment would permit the counting of two samples simultaneously; a gaseous sample contained in an Erlenmeyer flask and a two-inch planchet sample placed in a separate chamber.


SCINTILLATION CHAMBER, INTERIOR COATED WITH SILICONE AND ZnS PHOSPHOR
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PREAMPLIFIER AND DISCRIMINATOR
110 V. A.C.
HIGH VOLTAGE OUTPUT
SCALER INPUT
NUCLEAR CHICAGO MODEL 186 SCALER
110 V. A.C.

**Fig. 1. SKETCH OF ORIGINAL Scintillation Detector and Scaler.**

The planchet chamber provides for the placement of an alpha or beta scintillation crystal inside a removal tray. The tray is constructed to press the crystal firmly against the two-inch photomultiplier tube when it is in place. The assembly includes a drawer for sliding the planchet into the assembly for counting.

The flask chamber consists of a light-tight metal enclosure inside the main cabinet. The five-inch photomultiplier tube protrudes into the bottom of this chamber into which Erlenmeyer flasks, up to one liter size, may be accommodated. Because of the large size photomultiplier tube a variety of size flask samples may be placed in the unit to determine optimum sample volume.

Printed circuit techniques were used throughout with fiberglas copper-backed board chosen because of its strength and ease of punching. Printed circuits are reproduced readily. A block diagram of the detection equipment is shown in Figure 2.

## System Components and Operation

The *high voltage power supply* consists of a transistor DC to DC converter, the input of which is 12 v at 1.7 amps, the output is 3,000v at a maximum of 5 ma. This unit is used in conjunction with neon breakdown diodes to supply regulated high voltage. A switch is employed at the two photomultiplier tubes which enables the operator to select any voltage for the anode of each photomultiplier from 700 to 2,100 v.

The *low voltage power supply* furnished regulated 105v DC power to the neon lamps used as the scaler readout. The unit requires 12v at 1 amp. Its output is 135v at 45 ma. It is also a DC to DC converter.

The *scalers* consist of 10 binary scaling stages capable of a maximum scaling rate of 150 x $10^6$ cpm. For operation at maximum speed, these binaries require a pulse width not to exceed 0.2 microsecond. The final stage of these scalers triggers a driver stage which is connected to an electro-mechanical counter which registers multiples of 1,024. The mechanical counter and the binary scaler are both manually resettable with a switch located on the front panel. The power required for each scaling unit is 12 v at 50 ma. The minimum input pulse amplitude is 4 v. Two of these scalers are incorporated into this unit.

The *single discriminator* consists of a video amplifier with a gain of 30 which delivers a pulse at the input gate of the one-shot multivibrator used as a base-level discriminator. The input of the video amplifier stage has a multi-pole switch which adjusts the input pulse am-

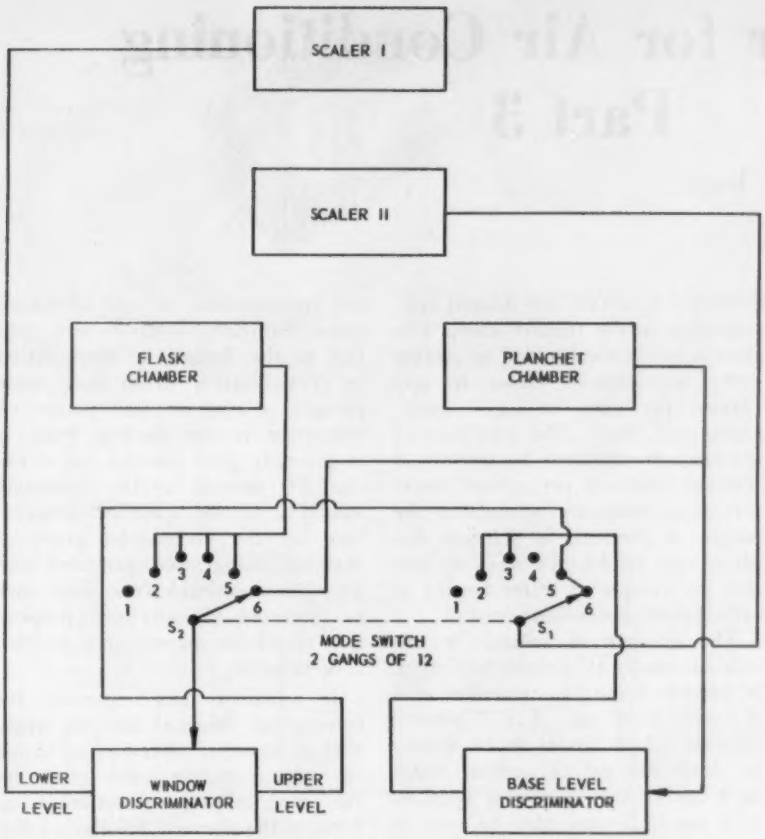


**Fig. 2. FUNCTIONAL DIAGRAM of Improved Detection Equipment (Transistorized Detector and Scalers).**

plitude. Between the video amplifier and the single discriminator there is a gate employing a diode clamp which allows a fine adjustment of the base-level trigger amplitude. An emitter-follower is incorporated in the output of the one-shot multivibrator to drive a length of a 50 ohm coaxial cable. This output, when selected through the mode switch, drives the input stage of the scaler No. 2.

The *window discriminator* incorporates a video amplifier stage, two one-shot multivibrators and an inhibit gate. The video amplifier stage has a gain of 30, a band width of approximately 6 megacycles and a rise time of about 50 mμs. At the input of the video amplifier a selector switch is incorporated which varies the input pulse amplitude to avoid overloading of the video amplifier stage when large amplitude input pulses are present. This switch functions also as a coarse gain control.

The output of the video amplifier is an emitter follower, driving two one-shot multivibrators through a diode gating circuit consisting of two DC base clamps. The reference voltage for these diode clamps is obtained from the two helipots located in the front panel of the instrument. This gate is constructed such that when one helipot (base level) is turned both clamps move up or down simultaneously. When the other helipot (window width) is turned the upper level one-shot multi-vibrator reference voltage moves up or down independently of the base level. This window discriminator may be used for pulse height analysis when calibrated with standard radioactive sources.

The window discriminator may be connected through the mode switch to either the planchet chamber or the flask chamber. A separate output is provided so that all the pulses which trigger the upper-level, one-shot multivibrator may be counted. Thus, one may observe all the pulses which lie in a particular energy range and also count all the pulses that are higher than the upper level of the window discriminator. The input to the window discriminator can also be connected through the mode switch to an external coaxial connector, hence to the output of a Nuclear Measurements Corporation proportional counter converter, Model PCC11A, or equivalent. With proper adjustment of the window discriminator, one scaler will read the total alpha count and the other scaler will read the beta count, provided that the alpha and beta energies do not coincide significantly.

The *neon readout* board consists of a transistor driver and associated circuitry which operates neon lights which are visible from the front panel of the unit. Both sets of scaler lamps are binary coded and, in conjunction with the appropriate mechanical register, are used to read total counts. The board is installed on the front panel of the instrument and requires —105 volts DC at 35 ma when all lamps are lit. The power is obtained from the low voltage DC to DC converter housed in the main printed circuit card file.

References will be included at the end of part 3.

## Saunders Begins Private Consultant Firm

Daniel J. Saunders, former vice president of Pfaudler Permutit Inc., has opened an office at 70 Pine St., New York 5, N. Y.

Saunders will engage in a wide range of management, sales and other consulting work for companies manufacturing engineered products. In addition, he will act as a consultant to organizations desiring technical services, where surveys, specifications, and recommendations are desired covering water and waste problems.

A past president of the Water & Sewage Works Manufacturers Association and director of American Water Works Association, Saunders has presented technical papers before the American Society of Mechanical Engineers, the Technical Association of the Pulp and Paper Industry, AWWA and the International Water Conference.

He is also the author of numerous articles on water technology and sales management.

# Cooling Water for Air Conditioning Part 3

by HENRY F. MUNROE, San. Engr.,
B-I-F Industries, Inc.
Providence, R. I.

■ MANY COMMON CHEMICALS are used for cooling water conditioning. New compounds are being offered every day; particularly in the case of algae and slime inhibitors. Continual research is showing that certain combinations of chemicals exhibit the desired properties needed for particular systems.

In the water cooled air conditioning system employing recirculation of cooling water, there is a continuous loss of water (by evaporation, blowdown and windage). In order to maintain a definite residual concentration of desired chemicals in the recirculating water, chemicals must be fed in an amount equal to the chemical loss from the system by blowdown or windage and proportioned to the input of make-up water. It is not strictly correct to add chemicals at a rate which would provide the theoretical concentration desired in the recirculating water. Dosages should be somewhat less than calculated amounts, since losses due to evaporation tend to continuously concentrate solids in the water.

In most cases the addition of chemicals is determined by trial and error, starting with a low dose and gradually increasing until the desired concentration is maintained in the recirculating water. After operating experience is obtained on a cooling tower, this concentration may be calculated in advance by determining the ratio between windage and blowdown losses, and evaporation loss. In any event, chemical feeders with wide adjustment ranges are desirable. For initial treatment of water for a recirculating cooling tower system, chemical addition sufficient to treat a volume equal to 0.75 hours flow may be used as a starting point.

### Chemical Calculations

In order to add chemicals as solutions in prescribed dosages, it is necessary to know the strength of the solution being fed and the volume necessary to obtain the desired concentration in the treated water. The amount of chemical added to cooling water is measured either in gpg (grains per gal) or mg/l (milligrams per liter). The chemical feeders are calibrated by volume of solution displaced per stroke, therefore it is necessary to balance the weight of chemical in solution displaced per stroke, the stroking rate and the volume of water treated in order to obtain a definite dose.

The strength of solution is calculated usually as percent by weight. It may be helpful to remember that it takes 36.34 ml. of a 1 percent solution (1 lb in 99 lb of water) to dose 100 gal of cooling water to 1 mg/l. Also, 1 gpg is equal to 17.1 mg/l. It may also be easy to remember that 8.34 lb of a chemical must be added to 1 mil gal of water to obtain 1 mg/l.

### Solution Preparation

One of the requisites for good water conditioning is exact preparation of the feeding solution. This requires some knowledge of the characteristics of the particular chemicals selected. Whenever possible, data regarding the purity and the solubility of the actual chemical to be used should be obtained from the chemical supplier. Data regarding the actual method of preparation of the solution or slurry and the maximum concentration which may be used also should be requested from the supplier.

The use of saturated solutions is not recommended except in special cases. Saturated solutions are subject to the danger of precipitation or crystallization which may cause plunger scoring on feed pumps or deposition in the feeding lines. It is generally good practice not to exceed 70 percent of the maximum solubility at the specified temperature for the commercial grade of chemical being used provided that no other undesirable conditions, such as increased viscosity or precipitation of soluble matter, arise at such concentration.

If solubility data regarding the commercial chemical are not available, a common procedure is to use 50 percent of the value given for the chemically pure substance as listed in the chemical handbooks. Extreme care should be taken when preparing a combined solution containing several solutes, and if at all possible this practice should be avoided.

The present practice is toward trying to feed chemicals in their most concentrated form. This practice may avoid the hazards due to dilution (sulfuric acid, for example) and may permit the use of smaller solution reservoirs and proportioning feeders, but it also accentuates the need for more effective dispersion of the chemical in the flow stream. Also, the feeding of highly concentrated chemical solutions usually requires special corrosion-proof sections at the injection point. To obtain the best results, the engineered system balances the undesirable char-

*The demand for human comfort through air conditioning has, in many places, burdened water supply and waste treatment facilities.*

*This series of three articles is presented to give readers an appreciation of problems surrounding the use of cooling water in air conditioning. The subject is outlined for presentation as follows:*

*Part 1—Water for cooling.*
*Part 2—Water treatment requirements.*
*Part 3—Instrumentation and control of water quality.*

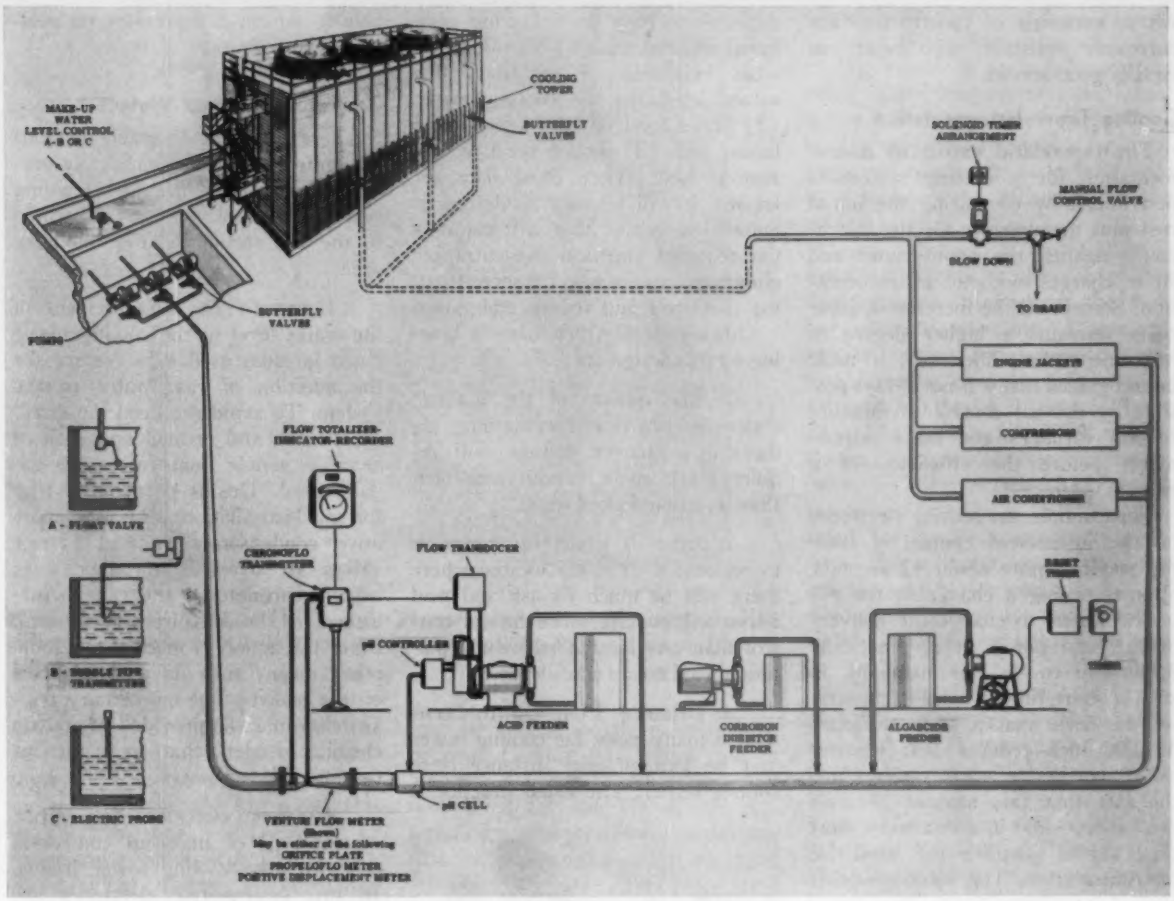


**FIG. 8. FLOW DIAGRAM for automated cooling water system. Methods for controlling the addition of make-up water are shown as inserts at the left.**

acteristics through the use of larger feeders and larger solution reservoirs. For example, the injection of sulfuric acid into a pressure line is very difficult. Special consideration must be given to prevent diffusion of water back through the concentrated reagent line to the solution reservoir. In such cases the heat of dilution is appreciable. The dispersal of the acid, or mixing, with the cooling water in the pressure line is also difficult to obtain. Actually, from a maintenance standpoint, the most desirable arrangement is to add the acid to an open channel through a feed line having a definite air break. Facilities can be placed in the channel to provide good mixing and good dilution.

### Chemical Feeding Systems

In designing a chemical feeding system for cooling water conditioning, three general treatment problems must be recognized: (1) scale formation, (2) corrosion, and (3) slime and algae control. It is possible to have all three of these problems occurring in different areas of a single cooling system. Although very careful consideration must be given to the selection of the chemicals and their concentrations to prevent scale formation and corrosion, it is equally important to introduce and apply the chemicals in a manner which will provide the desired control but prevent waste.

A common method of feeding chemical is to actuate a chemical feed pump by a switch controlled by a float riding on the surface of the liquid in the cooling tower basin. Assuming that a known amount of raw water will be added to increase the level in the basin, then the rate of solution feed and the solution concentration must be such that the required amount of chemical will be injected into the system to treat the input of raw water. Another method is to provide a contact (by a float or by probes) to actuate a reset timer which in turn operates the chemical feeder for a given period. The timer interval must be adjusted to permit delivery of the required amount. However, these methods only approximate flow proportional feeding. Since the chemicals are added to the system and not to the actual fresh make-up water, there is also a problem to disperse the added chemical throughout the flow volume.

When chemical solutions are added to a pressure line, the injection pressure governs the type of feeder to be used. Diaphragm feeders are used to inject against pressures up to 125 psi. For higher pressures, plunger type feeders are used. The diaphragm feeders are not plagued with the unsightliness of leaking stuffing boxes and are generally available in corrosion resistant plastic materials which permit them to handle practically all chemicals used in cooling water treatment. The careful selection of a plunger type feeder

whose materials of construction are corrosion resistant will result in equally good service.

### Cooling Tower Instrumentation

The economical extent of instrumentation for a cooling system is determined by comparing the initial cost plus maintenance for the instruments against the maintenance and labor charges without instrumentation. Sometimes the increase in labor costs warrants a higher degree of instrumentation. Then too, it must be recognized that it is not always possible by manual control to measure several variables and make adjustments before the efficiency of a process is affected.

For example, the sensing electrodes on the instrument control of cooling water require about 12 seconds, after recording a change in the pH of the water, to change the delivery of the acid pump. It is practically impossible to do this manually in such a short time. Therefore, merely on the basis that a scale thickness of .006 inch reduces heat transfer by 30 percent in some systems and the fact that this amount of scale can be deposited in a relatively short time almost justifies the need for instrumentation. The value of closer control is apparent.

The extent of instrumentation for a cooling tower system is governed by the size of the tower and the degree of treatment provided; all of which is related to the value of the equipment to be protected. An ideal instrumentation plan approaches a system which furnishes all the information required to complete an acceptance test. The Cooling Tower Institute Publication ATP-105 gives a suggested procedure for an acceptance test. Data required are as follows:

1. Temperature
   a. Air (wet bulb)
   b. Cold Water
   c. Hot Water
2. Flow
   a. Raw Water
   b. Circulating Water
   c. Blow down
3. pH
4. Wind Velocity
5. Power Input for Fan Driver
6. Pressure
   a. Recirculating Pump Suction
   b. Recirculating Pump Discharge

After obtaining all the above information, a plan for instrumentation can be developed. To assist in the development of the plan it is desirable to have the following additional information: (1) conductivity —an indication of the total dissolved solids in the cooling water, (2) liquid level in the cooling tower basin, and (3) liquid level in the suction well. When these data are known, it will be easy to design an automated system that will maintain the required chemical concentration, eliminate water waste, conserve treating chemicals and reduce manpower.

Other factors which have a bearing on this design are:

1. The quality of the makeup water. A raw water containing industrial wastes or sewage will require much more careful treatment than uncontaminated water.

2. Area in which the tower is to be located. A tower located where there will be much fly-ash and acid fumes will require more careful control than one located where air pollution need not be considered.

3. Distance from control center. In many cases the cooling tower may be located some distance from control center. The usual practice is to telemeter information about the tower to a central control point.

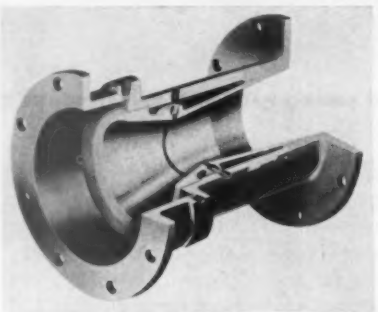

FIG. 9. DALL FLOW TUBE differential producer.

The instruments necessary to record information on the operation of the cooling system and those necessary to automatically control conditions in the system may be more easily discussed by referring to the flow sheet shown in Fig. 8. It is necessary for an automatic system to be capable of controlling makeup water, record the volume of makeup, recirculating and blowdown water, indicate temperature as a measurement of efficiency, record and control pH of the water, prevent dissolved solids buildup, and be able to sound an alarm or otherwise be able to inform a supervisor on cooling tower operation.

### Control of Make-up Water

There are three acceptable methods for controlling and automatically providing make-up water to a cooling system. Each of these is illustrated in the left section of Fig. 8. They are:

1. LEVEL: The measurement of the water level in the cooling tower basin is often used as a control for the addition of raw water to the system. To avoid the need for direct supervision and manual operation of a valve, simple float valves are usually used. This is particularly true for small installations such as evaporative condensers. Standard float valves are available for pipe sizes usually encountered and can be furnished for the pressures experienced. Since the action is mechanical, some other means such as a flow meter on the makeup line or mercury tripswitches must be provided to actuate chemical feeders that treat the incoming make-up water.

2. PROBE SYSTEM: The probe system type of make-up control is used in large cooling tower basins. In this system two electrodes are used, one to make a contact at high level and one to be uncovered or make a contact at low level. The probe system can be designed for a much wider range of control. The electrode system must be of waterproof construction and the electrodes should be placed in a quiescent section which is also the case with the float valve.

3. BUBBLE PIPE METHOD: For the very large towers, the air bubble pipe system is commonly used. This pneumatic system eliminates the need for electrical power at the tower. The system can be furnished with a local indicator or an indicator plus a transmitter so that the water level can be recorded at a remote location. The system is also adaptable to pneumatic control of make-up water, since any deviation in water level from a preset point may be used to proportionally position a butterfly valve in the makeup line.

### Metered Water Flow

A knowledge of the amount of makeup flow, the recirculating flow,

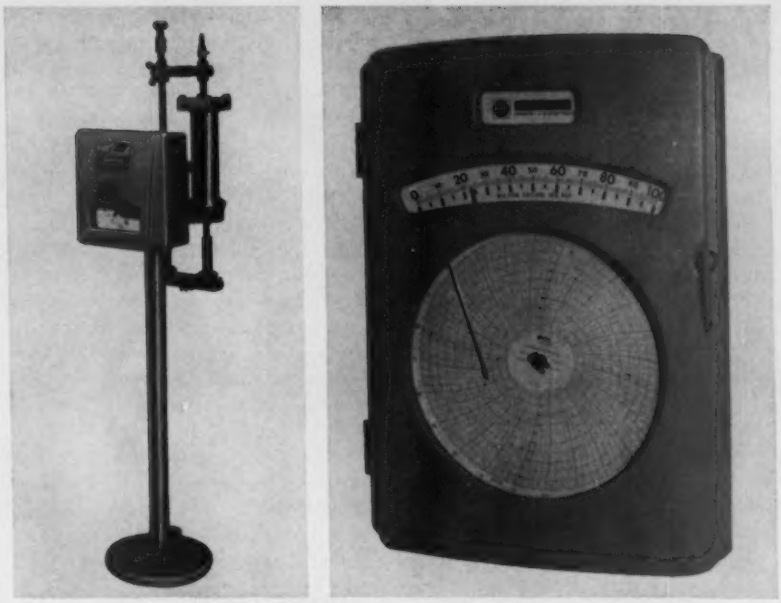

FIG. 10. FLOW TRANSMITTER and Chronoflo receiver, when connected to differential producer will indicate, record and totalize information on flow of water.

and the blowdown flow is pertinent to the efficient operation of a cooling system, and several types of flow meters are available to record this information. For small towers or evaporative condensers the positive displacement meter is commonly used to give an indication of rate and totalization of the flow. These mechanical meters may also be incorporated with a pacing device to provide for flow-proportional feeding.

For larger pipe sizes and for those installations where it is desirable to have a record of the flow, the velocity or inferential flow meter is used both on the raw and recirculating pipelines. Velocity type meters are not usually installed in blowdown lines where they may encounter high concentrations of suspended solids and debris.

Orifice plates and flow tubes or nozzles are termed inferential meters. Although the orifice plate has a low initial cost, the installation requirements are more critical and the period of sustained accuracy is shorter due to erosion of the orifice opening. In addition, the unrecoverable loss of head through the orifice plate is usually 70 to 80 percent of the differential which increases pumping costs. For installations where life expectancy and head loss are critical, the installation of a flow tube or venturi nozzle is more economical (Figure 9). Initial cost is higher but a high degree of accuracy is assured for the life of the differential producer. Head loss for the flow tube is in the order of 10 to 15 percent of the differential and installation requirements are much less stringent.

All of the differential producer type meters can be arranged to actuate local mechanical, pneumatic, or electrical indicating devices; or the information can be transferred to remote indicating, recording and totalizing receivers. The flow transmitter shown in Figure 10 can be combined with a receiver, to indicate, record and totalize the flow.

FIG. 11. TEMPERATURE TRANSMITTER which will obtain information from a sensing element and send it to a receiver.

### Temperature

Since the prime function of a cooling tower is to reduce recirculating water temperature, the measurement and control of temperature is very important. Temperature readings are combined with flow data to determine the efficiency of the cooling system.

Local indication of temperature is usually obtained by the use of dial thermometers inserted in the flow line. Remote recording of temperature is obtained by using a temperature sensitive element, a transmitter (Figure 11) and a receiver (Figure 12). The SAMA Class 1A sensing element is commonly used in the remote recording system. The remote recording system is fully compensated for ambient temperature effects, has a linear scale, rapid response, employs a small bulb, and eliminates the need for elevation correction. The temperature bulb may be located as far as 100 ft from the indicating instrument or transmitter. For greater distances (feet to miles) the system can be adapted to the time impulse telemetering system.

In cooling tower operations, it is important to record the temperature of make-up water, hot water to the tower, cold water from the tower, blowdown water, and wet bulb air temperature. For small installations, direct reading instruments are probably satisfactory but for large installations, and particularly those that are remotely controlled, a strip chart or round chart recorder should be used. Strip chart recorders with up to three temperature pens on a single chart and 30-day Strip charts can be obtained. A two pen instrument is shown in Figure 12.

### pH

The control of pH of cooling water is important not only from the standpoint of corrosion of the metal pipelines but also for the prevention of delignification of cooling tower wood. While pH is not the whole story regarding the corrosion of metals it does give a good indication and provides a good basis for control.

Control and measurement of pH involves many factors especially when chemical feeding equipment is automatically operated by signals from the pH sensing element. Before sensing the pH, it is important that added chemical be completely mixed

and generally, a length of pipe does not give sufficient mixing. After complete mixing, it is also important to allow enough time for the chemical to react. Both mixing time and reaction must be short enough to prevent having to locate the sensing element too far away from the feeding equipment thus causing an appreciable transport lag. Titration or reaction curves on the chemical being fed may be very helpful in this respect.

Electrode assemblies are available to accommodate practically every type of installation. Immersion types are used in open channels or tanks where there is little variation in water level. Water level is important when using immersion cells since only the tips of the electrodes are immersed. Submersion type assemblies are more popular for channels or tanks where the liquid level may vary. This electrode assembly may be completely submerged at practically any convenient depth. The use of the submersion assembly usually eliminates the cleaning difficulties created by surface scums and oily films.

For the pressure water line, two types of pH recorders are available. There are the atmospheric flow and pressurized flow type. The atmospheric flow type provides for the bleeding of a continuous stream of cooling water (2 to 5 gpm) from the pressure line through the electrode chamber to a drain. In some cases, a small sampling pump is used to pump the sample to the flow chamber. When a pump is used, a number of taps may be made on the pressure line at various points and the suction lines from each connected through a multiple valve to the pump. This arrangement permits a number of samples to be analyzed and results checked. Care must be taken with such an installation to prevent the use of long lengths of pipe since these add to the transport lag and may seriously interfere with the control system.

Where it is undesirable to bleed a sample from the system, the pressurized flow chamber or the gland assemblies are used. These assemblies may be installed directly in the pressure line at locations where they can be given the required attention. The assemblies are installed with stop cock so that the electrodes may be removed from the line under pressure. The assemblies themselves require a continuous air pressure some 5 psi above line pressure. When a number of assemblies are installed a switching station or solenoid valve arrangement can be provided to permit the pH at several points to be determined by a single amplifier or receiver.

Electronic converters are also available which will transmit a time impulse signal from the receiver to a remote recorder at the control center. All such recorders may be fitted with suitable signal lights or audible alarms to warn of malfunctioning equipment.

## Conductivity

The measurement of electrical conductivity of an aqueous solution is an excellent method of reflecting the dissolved solids concentration in a solution. Conductivity apparatus is used to good advantage in a cooling tower installation to indicate and record the dissolved solids concentration of the cooling water. Suitable alarms and switches can be connected to the apparatus to trip a solenoid-operated valve on the blowdown line when the dissolved solids in the cooling water exceed the allowable concentration. Conductivity cells are available in a wide range of cell constants and in a sufficient number of styles to accommodate most cooling tower applications.

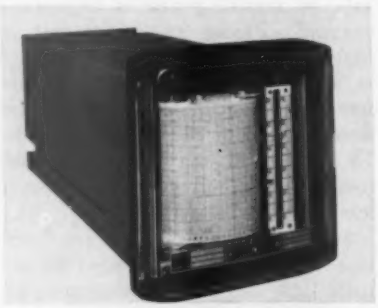

**FIG. 12. STRIP CHART temperature recorder has up to three pens and can be provided with a 30-day strip chart.**

Immersion cells are preferred for permanent installations in tanks. Insertion cells are used in pipelines and mounted in a manner that permits their withdrawal from the pipe line without loss of cooling water. Flow cells which rely on bleeding a sample from the system enable the cell proper to be located some distance from the sampling point much in the same manner as pH flow cells. Local indicating devices or transmitters can be furnished for reporting conductivity measurements or remote indication and recording can be installed using equipment similar to that used in pH systems. One important factor must be adjusted for in the installation of a conductivity cell and that is the effect of temperature. It must be recognized that a 10°F increase in temperature increases the conductivity measurement in an amount proportional to an 11 percent increase in concentration. For this reason, it is very desirable to use equipment which has automatic temperature compensation built into it.

## Central Control Stations

With the rapid development of continuous automatic measuring, analyzing and self-correcting devices for cooling tower operation, it has become quite common to telemeter the end results to a central control panel or information center. This arrangement is especially beneficial since cooling towers or condensers are usually located in areas remote from centers of activity. A centralized panel can be furnished that will allow all this information to be recorded at any location desired.

The panel itself may be very simple, serving only as a convenient means for mounting the instruments or it may be more elaborate, reporting graphically the flow of water through the various elements of the system and showing which valves are open, which pumps are running, etc. The panel may include visual and audible alarms that will respond when abnormal conditions are encountered.

The panel may also be equipped with controls to permit supervisory personnel to make corrections from the control center. When permanent records are obtained by accurate instruments, it is possible to note any changes in the cooling system such as abnormal raw water quality, leaky jackets or tubes, etc. The maximum benefits from the chemicals used with the lowest maintenance and replacement costs are more easily obtained by continuous recording and controlling of the various cooling tower variables.

**This is the last of a 3-part series on cooling water. Parts I and II have been published in previous issues.**

RESEARCH PROGRESS REPORT

# Antibacterial Activity of Oscillatoria Formosa Bory Extract

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■ ALTHOUGH THE antibacterial activity of extracts of certain forms of Chlorophyta, Phaeophyta, and Rhodophyta has been reported from several laboratories,[2, 10, 11, 13, 14, 15, 16] little information is available about the antibacterial action of the Cyanophyta or their exudates.

It has been reported that *Microcystis aeruginosa* Kutz. possesses some antibacterial properties against certain Gram-positive and Gram-negative bacteria[12, 19]. Bishop, Anet and Gorham[1] obtained negative results from tests on the antibiotic action of *M. aeruginosa* extracts against two strains of *Bacillus subtilis* and one strain each of *Staphylococcus aureus, Escherichia coli* and *Pseudomonas hydrophilia.* Under laboratory conditions *Oscillatoria splendida* Grew secreted a volatile substance which killed bacterial associates and other microorganisms in the algal culture[9]. Based on data obtained from laboratory tests on the antibacterial activity of certain blue-green algae, Flint[6] suggested the Cyanophyta as a possible source of additional antibiotics. Davidson[4] demonstrated the presence of a substance in certain Cyanophyta which inhibited pigment formation in *Serratia marcescens* Bizio.

Little is known of the chemical nature of the active principle in these blue-green algae, and no attempt has been made to correlate the antibacterial activity with known algal materials. Eighteen amino acids have been isolated from *Microcystis aeruginosa, Anabaena cylindrica,* or *Phormidium* sp.[7] Work and Dewey[18] found that *Anabaena cylindrica, Oscillatoria* sp. and *Mastigocladus luminosa* contain another amino acid, α-ε-diaminopimelic acid (DAP). Simmonds[17] found DAP to be active against *Staphylococcus aureus, Escherichia coli,* and *Streptococcus pyogenes.*

During recent studies on the effects of blue-green algae extracts on certain forms of bacteria, the possible existence of an antibacterial substance in some of the algae was indicated. The first antibacterial activity was observed in cultures of *Salmonella enteritidis* which had been treated with an aqueous filtered extract of *Oscillatoria formosa.* In view of these preliminary results, further tests were made to determine the possible antibacterial activity of the extract against certain other bacteria, including *Salmonella typhosa, Shigella dysenteriae,* and *Staphylococcus aureus.* Crude extract exhibiting an inhibitory activity was subjected to paper chromatographic separation using a variety of solvent and buffer systems.

## Materials and Methods

### Culturing the Algae

The strain of *Oscillatoria formosa* (LB390) used in this investigation was obtained from the Indiana University stock culture collection. A bacteria-free culture of this species was established and maintained in Benecke's liquid medium and on Benecke's medium with 1.5 percent added agar. The stock culture room was provided with a constant temperature of 20-24°C, light intensity of 50-75 ft-c, and relative humidity of 50-60 percent.

In order to provide an adequate and reliable supply of algal material, bacteria-free subcultures were established in 500 ml Erlenmeyer flasks containing 250 ml Benecke's liquid medium. The flasks were agitated 8 hr each day on a continuous mechanical rocking device. Constant illumination (500 ft-c) was provided by 40W cool-white fluorescent tubes, and the room temperature was thermostatically controlled at 26-30°C.

### Preparation of the Algal Extract

The method employed in the preparation of an aqueous extract containing the antibacterial factor was a modification of the alcohol extraction method previously reported[5]. A mass of fresh algae was transferred to a pyrex test tube, frozen with acetone-dry ice at −78°C for 1 hr and dried under reduced pressure (0.5 mm Hg) for 8 hr at 26-30°C[8]. The dried material was ground in a glass tissue grinder with absolute ethanol for 30 min at room temperature. Microscopic examination of the suspension revealed that the algal cells were thoroughly disintegrated. The mixture was centrifuged and the supernatant was transferred to a separate container. Two additional ethanol extractions of the residue were made. The supernatants from the three extractions were pooled and the ethanol was evaporated under reduced pressure in a water bath at 40°C. In order to weigh only the water-soluble material in the crude extract, sterile distilled water was agitated with the residue for 4 hr and the solution was transferred to micro-weighing bottles. Spectrophotometric examinations of the solution revealed that the extract was well in solution and no pigments were present. After the water had been evaporated *in vacuo,* the residue was weighed and dissolved in absolute ethanol for filtration. In order to provide adequate sterilization of the filtrate and to avoid the possible adsorption of the active principle by paper or porcelain filter, a sintered-glass bacterial filter (porosity 0.9-1.0) was used. After filtration, the solvent was again evaporated *in vacuo.* A measured amount of sterile, glass-distilled water was drawn through the filter and agitated with the residue for 4-6 hr by a

magnetic stirrer. Samples of the extract tested on nutrient broth and on nutrient agar for the presence of bacteria were negative.

### Testing the Extract

The four species of bacteria used in these tests were obtained from the American Type Culture Collection, 2112 M St., N.W., Washington 25, D. C.: *Salmonella enteritidis* (13076), *S. typhosa* (167), *Shigella dysenteriae* (12021), and *Staphylococcus aureus* (9144). Tests by the Texas State Department of Health, Austin, Texas, revealed that the strain of *S. aureus* used was coagulase positive. Stock cultures of these species were maintained at 10°C on a medium consisting of Difco blood agar base 29 g, Difco nutrient agar 15.5 g, and distilled water 1000 ml. The medium was adjusted to pH 7.0-7.2.

Typical colonies of a 24-hr nutrient agar slant of the test organism were used to inoculate 15 ml nutrient broth in a graduated centrifuge tube. After 9-11 hr incubation at 37°C, the culture was centrifuged for 1 hr. The packed layer of cells, which occupied approximately 0.05 ml, was removed and washed twice in sterile N saline. The washed cells were then suspended in 5 ml N saline. Another tube containing 15 ml nutrient broth was inoculated with 0.1 ml of the bacterial suspension and incubated for 9-11 hr at 37°C. The culture was centrifuged, the bacteria were washed as before and suspended in 5 ml N saline. The suspension was adjusted with N saline to read 45 percent light transmittance at wave length of 625 mμ in the colorimeter. This heavy suspension was used as the initial inoculum in the inhibition tests.

Twelve Bausch and Lomb "Spectronic 20" colorimeter test tubes were matched to read equally on the colorimeter. Five of the tubes each containing 48 mg dehydrated nutrient broth in 1 ml glass-distilled water were autoclaved at 121°C (15 lb pressure) for 20 min and cooled. A sterile aqueous solution of *Oscillatoria formosa* extract at 0.245 mg/ml concentration was added to the tubes and diluted with sterile distilled water so that each tube contained 6 ml of one of the following extract concentrations: 0.041, 0.081, 0.124, 0.163, or 0.204 mg/ml. The nutrient broth concentration (8 mg/ml) and the volume of medium (6 ml) in the tubes were the same throughout. Each dilution was inoculated with 0.1 ml of the N saline containing the bacteria to be tested and designated as culture (x). A series of five controls (y) containing 6 ml of the same extract concentrations in sterile nutrient broth as each of the dilutions in the culture series were prepared. To each of the tubes in the control series, 0.1 ml sterile N saline was added in place of the bacterial inoculum. A growth control (d) tube containing 6 ml sterile nutrient broth and 0.1 ml of the bacterial inoculum, and a nutrient broth control (c) containing 6 ml of sterile nutrient broth with 0.1 ml sterile N saline in place of the inoculum were made. The twelve tubes were incubated in a water bath for 24 hr at 37°C. In order to determine the period of most active growth of the bacteria, the optical density of the tubes was determined at 1 hr intervals during the incubation period and recorded as culture (x), control (y), growth control (d), and nutrient broth control (c). In the culture and growth control tubes, the period of most active growth occurred during the first 6 hr of incubation. During this period, controls (y) and nutrient broth control (c) showed no growth. Inhibition tests on the four species of bacteria were conducted simultaneously and under identical environmental conditions. The percent growth in extract-treated cultures during the logarithmic growth phase was expressed as the difference in the optical density of x and y, divided by the difference in the optical density of d and c, multiplied by 100. The growth control tube represented 100 percent growth. The percent inhibition in each extract dilution was calculated by subtracting the percent growth value from 100. Negative results represent stimulation of growth.

**Table I**

**Effect of Oscillatoria formosa extract on the growth of four species of bacteria**

| Test Organism | Extract mg/ml | Culture (x) | Control (y) | Growth Control (d) | Nutrient Control (c) | Percent Inhib. (I) |
|---|---|---|---|---|---|---|
| Shigella dysenteriae | 0.041 | 0.174 | 0.131 | 0.143 | 0.066 | 44.3 |
| | 0.081 | 0.237 | 0.201 | 0.143 | 0.066 | 53.3 |
| | 0.124 | 0.301 | 0.276 | 0.143 | 0.066 | 67.6 |
| | 0.163 | 0.357 | 0.337 | 0.143 | 0.066 | 74.1 |
| | 0.204 | 0.432 | 0.432 | 0.143 | 0.066 | 100.0 |
| Salmonella typhosa | 0.041 | 0.187 | 0.125 | 0.119 | 0.066 | —16.9 |
| | 0.081 | 0.252 | 0.201 | 0.119 | 0.066 | 3.8 |
| | 0.124 | 0.337 | 0.292 | 0.119 | 0.066 | 15.1 |
| | 0.163 | 0.376 | 0.337 | 0.119 | 0.066 | 24.6 |
| | 0.204 | 0.469 | 0.444 | 0.119 | 0.066 | 52.9 |
| Salmonella enteritidis | 0.041 | 0.222 | 0.147 | 0.143 | 0.066 | 2.6 |
| | 0.081 | 0.276 | 0.201 | 0.143 | 0.066 | 2.6 |
| | 0.124 | 0.367 | 0.292 | 0.143 | 0.066 | 2.6 |
| | 0.163 | 0.420 | 0.357 | 0.143 | 0.066 | 18.2 |
| | 0.204 | 0.495 | 0.444 | 0.143 | 0.066 | 33.8 |
| Staphylococcus aureus | 0.041 | 0.215 | 0.131 | 0.155 | 0.066 | 5.5 |
| | 0.081 | 0.276 | 0.201 | 0.155 | 0.066 | 15.8 |
| | 0.124 | 0.357 | 0.284 | 0.155 | 0.066 | 18.0 |
| | 0.163 | 0.409 | 0.357 | 0.155 | 0.066 | 41.6 |
| | 0.204 | 0.456 | 0.456 | 0.155 | 0.066 | 100.0 |

The data represent the optical density at wave length 625 mu., of extract-treated bacterial cultures and controls after 6 hr. incubation. The percent inhibition of growth (I) was calculated by the equation.

$$I = 100 - \left[ 100 \left( \frac{x - y}{d - c} \right) \right]$$

where x represents the optical density of the culture, y the control, d the growth control, and c the nutrient broth control. The growth control d represents 100 percent growth.

### Chromatographic Separation of Extract Components

The procedure for the chromatographic separation of the hydrolysate of crude extract of *Oscillatoria formosa* was a modification of the method described by Work and Dewey[18] for the isolation of α-ε-diaminopimelic acid from microorganisms. Dried crude extract of *O. formosa* was hydrolyzed with 10 ml 6N—HCl

under reflux for 24-30 hr. The HCl was removed from the hydrolysate by three evaporations to dryness *in vacuo*. The residue was redissolved in 6 ml water. Single-dimensional descending chromatograms were run at 26°C from 0.015 ml of the hydrolysate applied to No. 1 Whatman paper (400 X 20 mm) in an atmosphere saturated with the solvent. The solvent used was a mixture of acetic acid, 1 part, butanol, 4 parts, and water, 5 parts. Four chromatograms of the hydrolysate and two untreated strips were run from the same trough for 20 hr. The solvents were removed by a stream of dry air at 45°C. Two of the chromatograms were sprayed with ninhydrin in butanol (0.5 percent, w/v). The six strips were dried in an oven at 100°C for 2 hr and the appearance of stained zones were noted.

Four chromatograms, each treated with 0.015 ml of a 10 percent (w/v) aqueous solution of authentic DAP, were run with the acetic acid-butanol-water solvent in a separate trough in the chamber with the hydrolysate strips for 20 hr. The four chromatograms were air dried and two were sprayed with ninhydrin. The four strips were developed at 100°C for 2 hr.

Stained chromatograms of the hydrolysate contained a distinct purple zone with the same area and Rf value as the purple zone produced on the authentic DAP chromatograms. All other zones on the hydrolysate chromatograms were faint and were not further investigated.

### Testing the Separated Components

Transverse segments 5 mm in width were cut from unstained hydrolysate and DAP chromatograms in such a way that each segment contained one of the components. The location of each component was determined by its position on its corresponding stained chromatogram. Segments cut from untreated strips were used as solvent controls. The segments were placed in separate tubes of nutrient broth inoculated with *Staphylococcus aureus*. The cultures were incubated for 6 hr at 37°C. Two untreated cultures of *S. aureus* were used as growth controls.

### Effect of DAP on Bacterial Growth

A series of tests were made to determine the effect of pure DAP on the growth of *Salmonella enteritidis, S. typhosa, Shigella dysenteriae,* and *Staphylococcus aureus*. Four series of the following ten concentrations of DAP were prepared in nutrient broth and autoclaved at 121°C (15 lb pressure) for 20 min: 0.0017, 0.0034, 0.0051, 0.0068, 0.0085, 0.0102, 0.0119, 0.0136, 0.0153 0.0170 mg/ml. Each concentration in a series was inoculated with 0.1 ml of a broth culture of one of the four bacterial strains, prepared as in the crude extract tests. One control tube containing only nutrient broth inoculated with the bacteria was prepared for each series. The four series were incubated simultaneously at 37°C for 6 hr. At the end of the incubation period the optical density of each of the cultures was recorded and the percent inhibition in growth over the control was determined.

## Results

### Growth Inhibition

The results presented in Table 1 on the effects of filter sterilized *Oscillatoria formosa* extract on the growth of four species of bacteria are representative of 35 similar experiments. The data represent the optical density of extract-treated bacterial cultures and controls after 6 hr incubation at 37°C. The tubes designated as controls and nutrient controls did not change in optical density during the incubation period. The most effective extract concentration was 0.204 mg/ml, and within the range on concentrations employed, the degree of inhibition was proportional to the extract concentration. The extract was most effective against cultures of *Shigella dysenteriae* and *Staphylococcus aureus* in each of which 100 percent inhibition in growth was obtained in extract concentration of 0.204 mg/ml. A slight, but characteristic stimulatory activity was obtained in cultures of *Salmonella typhosa* treated with extract at 0.041 mg/ml concentration. Some inhibition of growth was observed in all extract-treated cultures *of Shigella dysenteriae, S. enteritidis,* and *Staphylococcus aureus*. The effectiveness of the antibacterial factor was uniform during the first 6 hr incubation, after which a gradual decrease in effectiveness was observed. After 8-10 hr incubation, there was little difference between the optical density of the extract-treated and untreated cultures. The cultures remained at pH 7.0 throughout the incubation period.

Heat sterilized extract at concentrations corresponding to that of the filter sterilized extract stimulated growth in each of the four bacterial strains.

### Extract Characteristics

Although the data presented do not reveal the chemical nature of the antibacterial substance, several biological properties of the crude extract and the inhibitor were noted. After the ethanol extract was filtered and the solvent was evaporated under reduced pressure, the residue was viscous and tacky. Complete sterilization of the crude extract was accomplished by filtration through a sintered-glass bacterial filter. The antibacterial factor was soluble in water or ethanol and was inactivated when autoclaved at 121°C (15 lb pressure) for 20 min. Numerous tests showed that autoclaved crude extract exhibited a stimulatory growth activity. The antibacterial activity was retained when the crude extract was stored in either a dehydrated condition, in solution with ethanol or in water at 4-6°C.

### Effect of Extract Components on Bacterial Growth

Chromatograms of the hydrolysate of crude extract showed a distinct purple zone with the same area and Rf value (0.011) as the purple zone produced on authentic DAP chromatograms. Segments from areas on the unstained chromatograms of the hydrolysate or DAP, corresponding in Rf value to the stained areas, exhibited an inhibitory activity in cultures of *Staphylococcus aureus*. The percent inhibition elicited by each of these fractions is shown in Table 2.

### Effect of DAP on the Growth of Bacteria

Concentrations of authentic DAP between 0.0017 and 0.0170 mg/ml (w/v) inhibited the growth of *Staphylococcus aureus, Shigella dysenteriae, Salmonella typhosa,* and *S. enteritidis*. The percent inhibition of the various concentrations is shown in Table 3.

## Discussion

Under the conditions of these tests, crude extract of *Oscillatoria*

**Table 2**

**Effects of components from unstained chromatograms of crude extract hydrolysate and of DAP on the growth of Staphylococcus aureus**

| | Treatment of Paper Strips | | |
|---|---|---|---|
| Test Organism | DAP | Extract Hydrolysate | Untreated (Solvent control) |
| Staphylococcus aureus | 50 | 40 | 0 |

The transverse segments (1 x 0.5 cm.) were cut through areas corresponding to the purple zones on the stained chromatograms. The data represent the percent inhibition in growth of cultures treated with the separated fractions over untreated controls.

*formosa* possessed a substance which inhibited the growth of *Salmonella enteritidis, S. typhosa, Shigella dysenteriae,* and *Staphylococcus aureus.* The inhibitory activity was evidenced by the fact that during the period of most active growth in untreated bacterial cultures, little or no growth was observed in extract-treated cultures.

The pH of each extract-treated and control culture was measured and recorded continuously during the incubation period with a Beckman pH meter and a recordograph. Since the pH value of the tubes remained at 7.0 throughout, change in pH as a possible cause of the inhibitory or stimulatory activity of the extract may be excluded.

There was close agreement between the growth curves obtained from successive experiments, provided the test conditions were well standardized. Erratic results were obtained if agar slants of the test organism used in the preparation of the inoculum were more than 24 hr old. Transfers from the original slant of the test organisms were made routinely on nutrient agar each day so that the bacteria used in the preparation of the inocula were of the proper age. After each experiment the 24-hr slant was discarded, since changes in growth characteristics frequently occur upon serial passages of a bacterial strain[8]. Broth cultures from which the N saline inocula were finally made were incubated 9-11 hr. In any case, broth cultures of the same age must be used in successive experiments in order to produce the same growth curve.

Since the bacterial concentration of the inocula affects the degree of growth inhibition in the extract-treated cultures, all inocula were adjusted with N saline to read 45 percent light transmittance at a wave length of 625 mμ on the colorimeter. Numerous tests in which different amounts of inoculum were used, showed that 0.10 ml gave the most satisfactory results. This amount of inoculum produced a uniform logarithmic growth phase in the four species, covering the first 6 hr of incubation. Since the growth inhibiting factor in the crude extract was unstable after prolonged storage in water, only fresh extract (1-2 hr) was used.

The results relative to the chromatographic separation of the extract components do not imply that diaminopimelic acid is the specific antibacterial factor present in the crude extract. The complex interactions between the many amino acids present in *Oscillatoria* must be analyzed before the antibacterial activity can properly be attributed to a particular chemical.

## Acknowledgement

This investigation was supported by a research grant E-1429 (c4) from the National Institute of Allergy and Infectious Diseases of the National Institutes of Health, United States Public Health Service.

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**Table 3**

**Effects of various concentrations of diaminopimelic acid on the growth of Staphylococcus aureus, Shigella dysenteriae, Salmonella typhosa, and S. enteritidis during an incubation period of 6 hr**

| | Per cent Inhibition in Growth | | | |
|---|---|---|---|---|
| Concentration mg/ml | Staphylococcus aureus | Shigella dysenteriae | Salmonella typhosa | Salmonella enteritidis |
| 0.0017 | 60 | 60 | 39 | 54 |
| 0.0034 | 79 | 66 | 49 | 57 |
| 0.0051 | 80 | 72 | 53 | 64 |
| 0.0068 | 80 | 85 | 62 | 74 |
| 0.0085 | 87 | 88 | 67 | 80 |
| 0.0102 | 80 | 88 | 77 | 87 |
| 0.0119 | 87 | 91 | 86 | 90 |
| 0.0139 | 94 | 97 | 91 | 97 |
| 0.0153 | 94 | 100 | 96 | 97 |
| 0.0170 | 100 | 100 | 100 | 97 |

# A Rapid Method For Analyzing the Performance of a Calcining Kiln

by CHARLES F. WHITCOMB, JR.,
San Diego, Calif.

■ THE CALCINING KILN might be thought of as a miniature blast furnace where the stack serves as the kiln. In this article the rotary type kiln will be discussed; however, the methods of analyzing its performance apply equally well to kilns of other types. The rotary kiln is a brick lined hollow steel cylinder set at a small angle to the horizontal. Hot gases and secondary air enter at the lower end while the raw material to be calcined enters at the other. The heat from fuel burning plus the hot products of combustion and gases driven from the processed material, pass along the cylinder and leave by the upper end. The solids are fed at the upper end and are worked, as the kiln rotates slowly, to the lower end where the finished product is discharged. This creates a counterflow type of action in which the process material moves in one direction through the reactor, while the end-products of combustion move in another.

### Chemical Reactions

Two important chemical reactions proceed simultaneously in the rotary calcining kiln. The first of these is the combustion reaction in which a hydrocarbon fuel is burned in air to produce heat; the second is the disassociation of the raw material (calcium carbonate) to form the product. These equations can be written as follows:

$$CH_4 + 2O_2 + 7.52\ N_2 \rightarrow CO_2 + 2H_2O + 7.52N_2 \qquad (1)$$

which is the simple form of the combustion reaction, and

$$CaCO_3 + \Delta\ (\text{Heat}) \rightarrow CaO + CO_2 \qquad (2)$$

which is the disassociation of the calcium carbonate by heat to form calcium oxide, CaO.

### Kiln Performance

Obviously the most important question concerning the operation of such a chemical processing unit is whether it is operating efficiently. Is it producing the required quantity and what is the rate of CaO production? It is necessary to know this in order to match the operation of the kiln to that of the chemical plant of which it is a component part.

The quality of the product must also be known. The discharge from the kiln will not be pure CaO. Intermixed with this calcium oxide will be various non-volatile compounds such as silica and iron complexes. The presence of these will be harmful to the proper employment of the product in the chemical plant processes. For this reason it is very important to analyze representative samples and determine the percent impurities in the product. This result is usually expressed as the percent available CaO in the product.

A very important feature of the operation of such a kiln is the heat rate. This will be the number of heat units consumed in the calcining of a unit of product. The heat must be supplied by the fuel and is therefore an important item of expense.

The heat rate, or throughput, cannot be based upon the gross rate of production but must be determined from the quality or the percent CaO in the product. The technique to be described involves the use of an exhaust gas analysis to arrive at the heat rate; and, when this value is used in conjunction with the gross weigh-out of product and the fuel flow, the quality of product can be predetermined.

## Gas Analysis as a Measure of the Performance

### The Fuel Used

Since the nature of the exhaust gas is determined to a considerable extent by the fuel employed it is necessary to look at the chemistry of a typical fuel for a rotary kiln. This is a gaseous fuel which may have the following composition:

| Constituent | Formula | Percent composition of Volume |
|---|---|---|
| Methane | $CH_4$ | 83.84 |
| Ethane | $C_2H_6$ | 9.22 |
| Propane | $C_3H_8$ | 2.36 |
| Isobutane $(CH_3)_3$ | $CH\ CH_3$ | 0.13 |
| Butane | $C_4H_{10}$ | 0.17 |
| Pentane | $C_5H_{12}$ | 0.28 |
| Nitrogen | $N_2$ | 3.60 |
| Carbon Dioxide | $CO_2$ | 0.40 |
| | | 100.00 |

To reduce the rate of fuel flow to the equivalent rate of flow of hydrocarbons it is necessary to multiply the metered volume by 96 percent—thus correcting for the 4 percent inerts in the above analysis. It is also necessary to compute the equivalent hydrocarbon molecular formula and molecular weight for the above mentioned mixture. To do this, the above percentages will be corrected to total a 100 percent hydrocarbon mixture. The proportional contribution of each molecular constituent can then be computed for the total weight of carbon atoms and hydrogen atoms in 100 ml of the gas. The computations are shown in Table 1.

So the equivalent molecular weight of the combustible mixture is . . .

$$\Sigma\,(E)/100 + \Sigma\,(F)/100 = 13.967 + 4.338 = 18.305$$

and the corresponding specific volume will be given by the expression . . .

$$PV = MRT \qquad (3)$$

so . . . $$V = \frac{MRT}{P} = \frac{1544}{18.305} \times \frac{520}{2120} = 20.6\ \text{ft}^3/\text{lb}$$

| Constituent | Formula | Volume in 96 ml hydrocarbons | Volume in 100 ml C/0.96 | $C_xH_y$ Carbon Atom Wt. (12 Dx) | $C_xH_y$ Hydrogen Atom Wt. (Dy) |
|---|---|---|---|---|---|
| A | B | C | D | E | F |
| Methane | $CH_4$ | 83.84 | 87.100 | 1046.00 | 349.00 |
| Ethane | $C_2H_6$ | 9.22 | 9.600 | 230.00 | 57.60 |
| Propane | $C_3H_8$ | 2.36 | 2.450 | 88.30 | 19.60 |
| Isobutane | $CHCH_3$ | 0.13 | 0.135 | 6.49 | 1.35 |
| Butane | $C_4H_{10}$ | 0.17 | 0.177 | 8.50 | 1.77 |
| Pentane | $C_5H_{12}$ | 0.28 | 0.290 | 17.40 | 3.48 |
| **Inerts** | | | | | |
| Nitrogen | $N_2$ | 3.60 | | | |
| Carbon Dioxide | $CO_2$ | 0.40 | | | |
| Sum (Σ) | | 100.00 | | 1396.69 | 433.80 |

and the density will be the reciprocal of this

or . . . $$\frac{1}{20.6} = 0.0485 \text{ lbs/ft}^3$$

The equivalent molecule may be written as

$$C_{1.38}H_{4.84}$$

## The Feed

The calcium carbonate fed to the rotary kiln will be mixed with various contaminating agents. Among these will be nonvolatiles such as silica, and volatiles such as organics. The organics can be oxidized in the kiln and thus produce $CO_2$. This will be mixed with the $CO_2$ from the combustion and the disassociation of the $CaCO_3$ and will necessitate a correction to the observed $CO_2$ reading.

## Chemistry and Mathematics of Performance

Let us rewrite equation (1) so that it will apply to the gaseous fuel mixture which we have found to be typical. Equation (1) now becomes . . .

$$C_{1.38}H_{4.84} + n(2.245)O_2 + n(8.44)N_2 \rightarrow$$

$$1.16\ CO_2 + 2.17\ H_2O + (n\text{-}1)2.245\ O_2 + n(8.44)N_2 \qquad (4)$$

which is the revised equation for the combustion. In this expression, n will represent the ratio (actual/ theoretical) for the air used for combustion. To facilitate the computation of mass flows for the fuel and $CO_2$, the molecular weights in the above molecular formulae for fuel are 18.305 and for $CO_2$, 51.04.

The laboratory analysis of the exhaust gas will give the ratio of the free oxygen to the nitrogen present. With this, which we will denote by $O_2/N_2$, we will start our mathematical treatment of the performance. Reference to equation (4) will show that . . .

$$\frac{O_2}{N_2} = \frac{(n\text{-}1)\ (2.245)}{8.44n} = 0.266\,\frac{(n\text{-}1)}{n} = 0.266 - \frac{0.266}{n}$$

and

$$\frac{0.266}{n} = 0.266 - \frac{O_2}{N_2} \qquad (5)$$

The ratio of the $CO_2$ in the sample resulting from combustion to the nitrogen present, $\left(\frac{CO_2}{N_2}\right)_c$, is obtained from inspection of equation (4) and will be found to be . . .

$$\left(\frac{CO_2}{N_2}\right)_c = \frac{1.16}{n(8.44)} = \frac{0.1370}{n} \qquad (6)$$

From a comparison of (5) and (6) we see that . . .

$$\left(\frac{CO_2}{N_2}\right)_c = 0.1370 - 0.516\,\frac{O_2}{N_2} \qquad (7)$$

The sample analysis will give the observed ratio of $CO_2$ to $N_2$ in the exhaust gases. We will call this . . .

$$\left(\frac{CO_2}{N_2}\right)_o$$

and the portion of this due to disassociating $CaCO_3$ will be . . .

$$\left(\frac{CO_2}{N_2}\right)_o - \left(\frac{CO_2}{N_2}\right)_c - K_o$$

where $K_o$ is the correction for the presence of organics, etc. in the feed, $CO_2$ in the fuel, etc.

The ratio of the $CO_2$ from the disassociating $CaCO_3$ to that from combustion will be denoted by $R_{co_2}$, and will equal. . .

$$\frac{\left(\frac{CO_2}{N_2}\right)_o - \left(\frac{CO_2}{N_2}\right)_c - K_o}{\left(\frac{CO_2}{N_2}\right)_c} = R_{co_2}$$

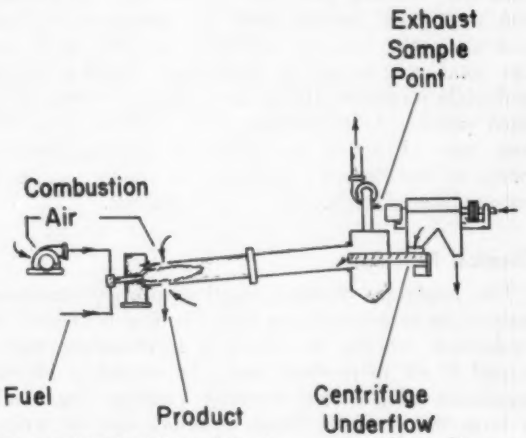


**FIG. 1 ROTARY KILN of the type commonly used in calcining.**

and the weight of CaO produced per hour, $Q_{cao}$, expressed as follows:

$$Q_{cao} = (\text{Weight of fuel gas per hr.})\left(\frac{1.16 \times 44}{18.305}\right)(R_{co_2})\left(\frac{56}{44}\right),$$

$$\text{or } Q_{cao} = 3.57\ Q_f R_{co_2} \qquad (8)$$

where . . .

$Q_f$ = rate of fuel flow in lbs per hour

Let $Q_g$ be the gross throughput as weighed-out product. Then the quality of the product, can be denoted by . .

$$P_p = \frac{Q_{cao}}{Q_g} \times 100 \qquad (9)$$

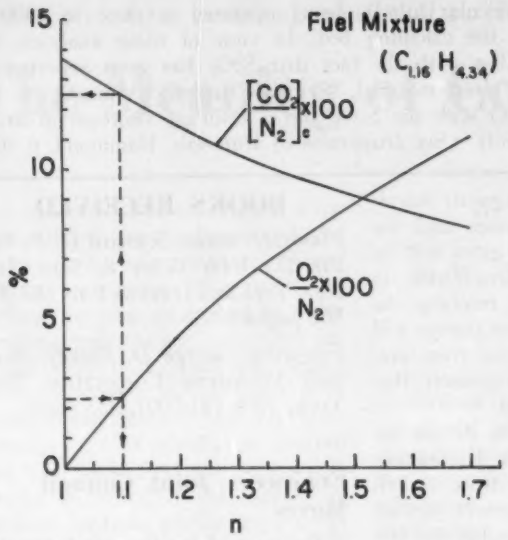


**FIG. 2. RATIO of actual against theoretical for combustion air composition.**

In a like manner, the heat rate will become . . .

$$Hr = (Q_f V \times \frac{1089}{0.96}) + (\frac{3.57 Q_f R_{CO_2}}{2000})$$

where **V** is the specific volume of the fuel and the 1089 is the heating value of the original fuel is Btu/ft³. This last is divided by 0.96 to convert to value for hydrocarbon mixture. This may be reduced to . . .

$$H_r = (Q_f)\ (20.6)\ (1135)\ (2000) \div 3.57\ Q_f\ R_{CO_2} =$$

$$\frac{46{,}700{,}000}{3.57\ R_{CO_2}} = \frac{13{,}100{,}000}{R_{CO_2}} \frac{Btu}{ton} \text{ of CaO} \qquad (10)$$

By subsituting various values of **n** in equations (5) and (6), we find corresponding values for $\left(\frac{O_2}{N_2}\right)$ and $\left(\frac{CO_2}{N_2}\right)_c$. These values are then plotted as ordinates against the various values of **n** as the abscissa. The resulting two curves make a handy graph for quickly picking off the $\left(\frac{CO_2}{N_2}\right)_c$ and the excess air after the ratio $\frac{O_2}{N_2}$ has been computed from the laboratory exhaust gas analysis. These curves are represented in Fig. 2.

The curve of Figure 3 in like manner represents the heat rate relationship as expressed in equation (10).

## Example Calculation

The following is an example calculation using data obtained from an operating kiln:

Example: A calciner is under test and the following instrument readings and sample analyses obtained:

**Data**

$Q_f$ = 10,130 ft³/hr × 0.96 × .0485 lb/ft³ = 9700 × .0485 lb/hr.

$Q_g$ = rate of production (gross) = 1750 lbs/hr.

$K_o$ = $CO_2$ equivalent of organics in feed to kiln (from feed analysis) = 6.3% of $CO_2$ from combustion.

Temperature of calcining bed = 2270°F+

**Gas analysis: %**

$CO_2$ = 19.30

$O_2$ = 1.98

$N_2$ = 78.72

100.00

**Observed gas ratios:**

$\frac{CO_2}{N_2} \times 100 = 24.5\%$

$\frac{O_2}{N_2} \times 100 = 2.51\%$

**Computation**

From equation (7) . . .

$$\left(\frac{CO_2}{N_2}\right)_c = 0.1370 - 0.516 \frac{O_2}{N_2} = 0.1370 - 0.0129 = 0.1241$$

Then

$$R_{CO_2} = \frac{(0.245\text{-}0.124)\text{-}(0.063 \times 0.124)}{0.124} = \frac{0.1132}{0.124} = 0.914$$

From equation (8) we have the rate of liberation of CaO in the kiln as . . .

$Q_{CaO} = 3.57 \times 9700 \times .0485 \times 0.914 = 1530$ lbs/hr.

The quality of the product will equal . . .

$$P_p = \frac{Q_{CaO}}{Q_g} \times 100 = \frac{1530 \times 100}{1750} = 87.3\%$$

The heat rate will be as follows:

$$H_r = \frac{13{,}100{,}000}{R_{CO_2}} = \frac{13{,}100{,}000}{0.914} = 14{,}320{,}000 \text{ Btu/ton CaO}$$

or

14,320,000 × 0.90 = 12,900,000 Btu/ton of 90% CaO.

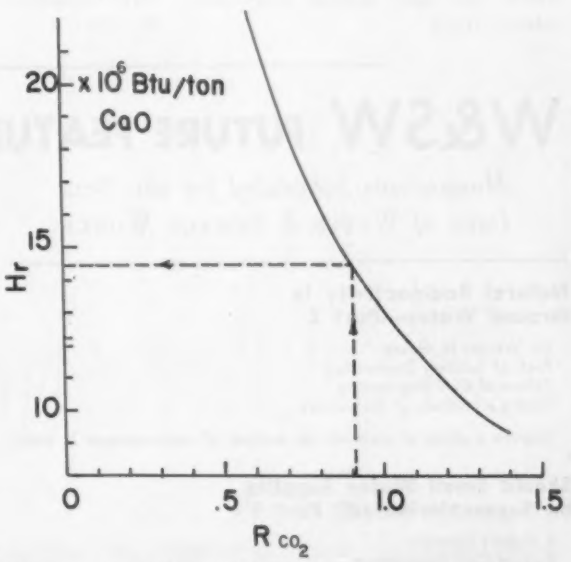


**FIG. 3. RELATIONSHIP between the ratio of carbon dioxide $R_{CO_2}$ (disassociating $CaCO_3$ to combusting fuel) and the heat rate.**

In connection with the quality computed above, it should be noted that the laboratory report on the product showed 86.4 percent calcium as CaO and 76.9 percent available CaO. Also, a typical analysis of the feed solids, when corrected to product, showed 86.8 to 87.2 percent total calcium as CaO. This particular kiln is being operated at close to 2300°F on the calcining bed. In view of these analyses, together with the fact that $SiO_2$ has been reported in the feed material, we may suspect a fluxing of the CaO with the $SiO_2$ and a resulting decrease in availability. (See *Dispersion of Materials*, Hammond, p. 92).

## $1.5 Million Contract for Five Giant Worthington Pumps

The U. S. Corps of Engineers has awarded a $1.5 million contract to Worthington Corporation, Harrison, N. J., to supply Providence, R. I. with five giant pumps—the world's largest—for use in conjunction with the nation's first hurricane dam.

The pumps, to be built by the Company's Harrison Division, are of the vertical propeller type, each measuring more than 20 ft in diameter and approximately 31 ft from end to end. They will be installed side by side to comprise the largest pumping facilities in the world. Combined, they will be able to pump more than 4½ billion gallons of water per day.

The Fox Point Dam, which is expected to be completed by 1964, will stretch 680 ft across the Providence River and will offer downtown Providence, which is below sea level, complete protection against raging storm waters caused by hurricanes. The dam will have three river gates on the east section, each with openings 40 ft wide, through which will pass normal river and tidal currents.

In order to guard against hurricane floods in Providence and the surrounding areas, the gates will be closed, preventing storm tides in Naragansett Bay from reaching the shores. The Worthington pumps will handle overflow from the river and its tributaries into Naragansett Bay when the gates are closed.

The pumps are each driven by 4500 horsepower motors. The motors as well as electrical controls, switch gear and power transformers, will all be supplied by Worthington for the pumping station which will be located at the center of the barrier. Delivery of the first unit is expected to be June 15, 1963.

## Proceedings Of The 1960 Cincinnati Seminar Available

Water Quality Measurement and Instrumentation, the Proceedings of the 1960 Seminar at Cincinnati, Ohio, has been released by the Robert A. Taft Sanitary Engineering Center.

The Technical Report, W61-2, is available in a limited number of copies by request from the Department of Health, Education, and Welfare, Public Health Service, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio.

## BOOKS RECEIVED

*Fluid Mechanics*. Richard H. F. Pao, Ph. D., John Wiley & Sons, Inc., New York and London, 1961 ($7.50). 502 pages.

*Filtration*. George D. Dickey, Reinhold Publishing Corporation, New York, 1961 ($12.00), 353 pages.

## Engineers Joint Council Moves

Engineers Joint Council, federation of 24 engineering societies, changed its address September 5. It joined 18 other major engineering groups in the new United Engineering Center between 47th and 48th Sts. facing United Nations Plaza in New York.

New quarters of EJC are on the third floor of the new building and the new address is 345 E. 47th St., New York 17, N. Y. The new phone is New York, Plaza 2-6800.

This, too, is the new address for the organizations for which EJC is the secretariat. They include the Engineering Manpower Commission; IAESTE; the U.S. Committee on Large Dams (USCOLD) and the World Power Conference. "ENGINEER", EJC's national newspaper may also be addressed here.

# W&SW FUTURE FEATURES . . .

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### Algae Aid in Sewage Nutrient Removals

Prof. R. H. Bogan
Dept. of Civil Engineering
University of Washington

A RESEARCH PROGRESS REPORT of advances in Nutrient Removals.

### Operation and Maintenance of Sewage Lagoons

C. W. Brinck
Director, Div. of Environmental Sanitation, Montana State Board of Health

Montana's story of lagoon practices and their success.

Some very cogent comments worthy of careful consideration on . . .

# The Meaning of Coliform Results

By GERSON CHANIN, East Bay Municipal Utility District, Oakland, Calif. and F. W. HARTMANN and M. F. LOLLICH, California State Department of Public Health, Berkeley, Calif.

■ NUMEROUS INVESTIGATIONS HAVE substantiated the usefulness of the coliform index as an indicator of unsanitary conditions. The results of coliform analyses as applied to water sampling and testing . . . "are intended only to indicate the degree of contamination of the water with wastes from human and animal sources . . . It should be realized that this, Most Probable Number, is merely an index of the number of coliform bacteria which, more probably than any other number, would give the results shown by the laboratory examination. It is not an actual enumeration of the coliform bacteria in any given volume of sample. . . The results of routine bacteriologic tests cannot be considered as providing complete or final information concerning the quality of water. . ."[1]. Despite these rather short but excellently worded sentences in *Standard Methods* the results of coliform tests have been misused and misinterpreted over and over again by a great many scientists, engineers, governmental officials, and others. Instances where a water supply or well was accepted or rejected on the basis of a single coliform test are well known. The results of the coliform tests on only one set of sample collected from San Francisco Bay have been used to define an area of contamination. This instance is described in this paper.

Even an evaluation based upon a great number of coliform tests collected over an extended period of time may be misleading. In another case to be described in this paper, conclusions were drawn upon the examination of almost ten year's coliform data employing the methods ordinarily used in the handling of such data. A more detailed evaluation of this same data could not definitely substantiate the conclusions which had been drawn, though their inference seems reasonable.

The purpose of this paper is not to undermine the significance of the coliform tests, nor will any recommendations be made toward the solving of the problems associated with the application of such data. It is the purpose of this paper to point out some of the difficulties which have arisen in the interpretation of the significance of the coliform analyses. It is hoped that through the airing of these problems those who must draw conclusions on a basis of coliform data will avoid certain pitfalls: 1. Drawing conclusions from the results of only a small number of tests. 2. Drawing conclusions from a large number of tests without a thorough statistical analysis or other critical evaluation. 3. Drawing conclusions concerning the relationship between two variables of a system without evaluation or control of the many other variables which may be concerned. For example, attempting to evaluate the relationship between the coliform count and the temperature in a natural environment without evaluating other factors such as weather conditions, sedimentation, adsorption, antibiotic effects, scavenger effects, and a great many others.

## Examples

The first case to be discussed is concerned with an attempt to follow the changes in pollution of the receiving body of water which would result from the institution of sewage collection and treatment in a large urban community on the east shores of San Francisco Bay. At one time it was hoped that by sampling at a readily accessible point, it would be possible to follow the changes in pollution which resulted because of

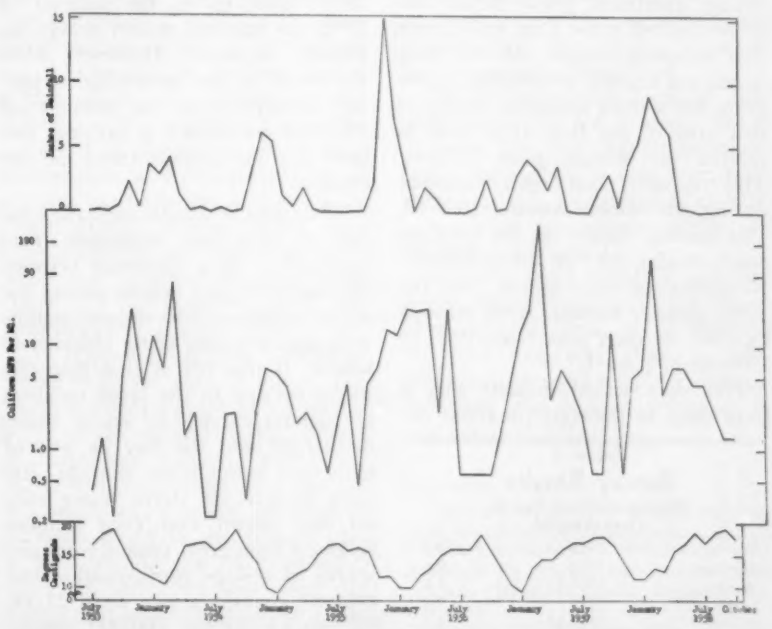


FIG. 1. RESULTS OF THE ANALYSIS of samples collected from the Bay during the period from July 1953 to October 1958.

[1]Presented at the Laboratory Section APHA National Conference, November 1, 1960.

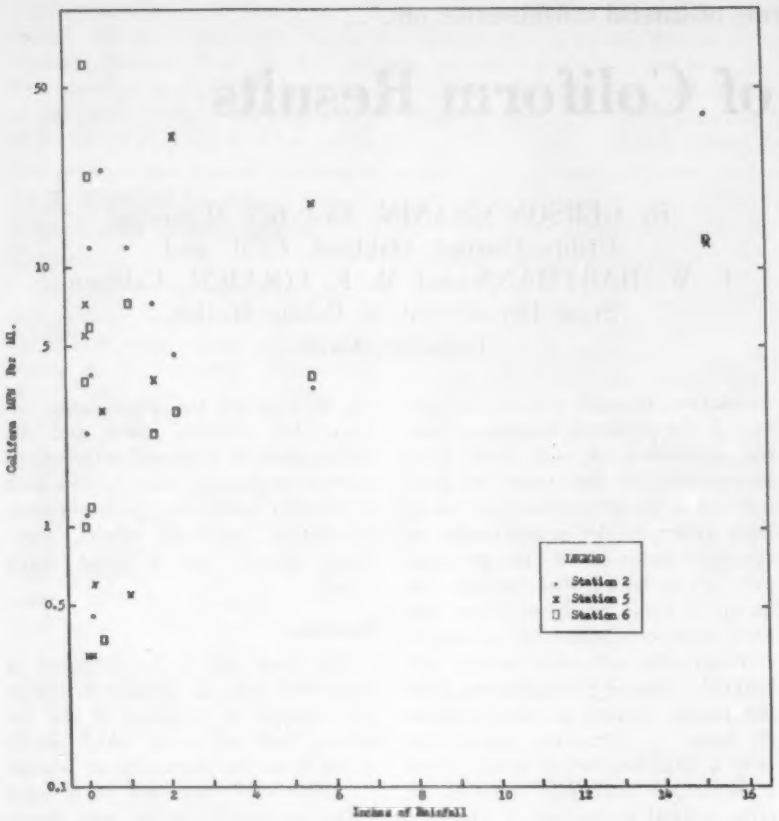



**FIG. 2. AVERAGE MONTHLY coliform counts at three sampling stations vs total monthly rainfall 1955.**

the operation of this new sewage treatment facility, even though the sewage treatment plant outfall was to be located some four miles from that sampling station. At that time it was not feasible to establish a program for a more complete testing of that area of the Bay which was to receive the sewage plant effluent. This treatment plant began operations during the winter months 1951-52. The median values of the coliform counts during the five winter months, November through March, and the seven summer months, April through October, of each year from 1950 to 1954 are in Table 1.

This data would indicate that a large drop in the coliform count occurred between the 1950-51 winter season and the summer season of 1951; then, up to the summer of 1952, the bacterial counts slowly but steadily increased. However, when the results of the bacteriological testing subsequent to the summer of 1952 are considered, it becomes evident that the original trend did not continue.

**Table 1**
**Survey Results**
**Median Coliform Values**
**Organisms/ml**

| | | |
|---|---|---|
| Winter | 1950-51 | 24.0 |
| Summer | 1951 | 0.6 |
| Winter | 1951-52 | 1.6 |
| Summer | 1952 | 2.3 |
| Winter | 1952-53 | 3.3 |
| Summer | 1953 | 1.3 |
| Winter | 1953-54 | 12.7 |
| Summer | 1954 | 1.4 |

When similar data through the summer of 1958 was examined, there appeared to be a difference between the bacteriological counts during the winter months and the summer months with higher values being obtained in winter. It was felt at first that this might be due to the large numbers of bacteria carried by storm water discharged into the Bay by way of numerous storm water outfalls. Results of tests of storm water runoff had shown that even samples collected from areas remote from any source of sewage contamination had coliform counts varying from 23,000 to more than 700,000 organisms/100ml.

Since the temperature, of course, also varies between winter and summer it was then felt that the variation in coliform counts might relate in some way to the water temperature. Zobell[2] and Orlob[3] indicated that whatever biological mechanism may be responsible for the die-off of coliform bacteria in marine waters, this mechanism is enhanced during the warmer summer months. A great many other factors are, of course, involved in or responsible for the differences between the coliform counts of the winter months and the summer months. If what has been said is true one might expect the coliform counts to vary directly with the amount of rainfall and inversely with changes in temperature. Graphs were prepared by plotting the average monthly water temperature at the time of sampling and the total monthly precipitation against the median monthly coliform counts for the period from July, 1953 through October, 1958, Figure 1. Though the relationships previously mentioned were observed in these graphs, a further analysis of the data did not reveal a definite correlation between either the amount of rainfall and the coliform count or the temperature and the coliform count. An example of the lack of correlation in the rainfall and the coliform count is shown in Fig 2 where the points on the scatter diagram have no tendency to form a straight line. This, however, might be expected because of the inability to control, in a natural environment, all of the many variables which have an effect upon the bacteriological count of the Bay waters. Therefore, though it may be concluded that the counts are greater in the winter months and lower in the summer months it cannot be said that the rainfall during the winter caused the high counts, or that the increased temperature during the summer months lowered the bacterial counts.

### Insufficient Data

Another case in which there was hasty judgment in the utilization of the data from coliform determinations was in an official report on the effects of a sewage treatment plant effluent upon San Francisco Bay. On the basis of only one sample from each of some 57 stations along a 21 mile shore front, a report and a map were prepared showing that a very large area of the Bay had been "dedicated to waste disposal".

Since that report, a more complete bacteriological study has shown that the area referred to was less than one one-hundredth of that originally indicated on the basis of the results from only one set of samples. The later results are based upon the median values of approximately 1000 bacteriological tests performed over a six-month period.

It is evident that an erroneous impression of the average pollutional pattern may arise when the results of a single day's tests are considered. On several different days, for example, the bacteriological counts were quite low and relatively constant over the entire area sampled, even in the area immediately over the outfall sewer. One particular day, the count at every station was 23 coliforms/ml, save one or two which were even lower. On other days, the bacteriological counts were quite high over a wide area, even at those stations relatively remote from the outfall sewer. On still other days a more typical picture was obtained, that is, high bacterial counts in the vicinity of the outfall area, somewhat higher counts in the direction of the tidal movement, and diminishing counts over increasing distances in the direction of the tidal flow. On other occasions the bacterial counts obtained apparently bore no relationship either to the tidal movements or to the proximity of the outfall sewer. In fact, at times the highest counts were found in a direction uptide of the outfall sewer.

It seems evident, therefore, that conclusions based upon only one day's sampling, or on only a few sets of samples, cannot reveal a true picture of what is occurring in a complex situation where treated sewage effluent is being discharged into tidal waters. It seems that conditions other than the discharge of the sewage may at times determine the coliform count. Such conditions may include tidal movements, wind, wave, temperature, and the like. However, a large number of samples collected over a long period of time will give a fairly good indication of the pattern of pollution in a case such as the one discussed above.

Still another problem in the interpretation of coliform data results from the fact that storm water discharges may enter the picture and yield confusing results because of

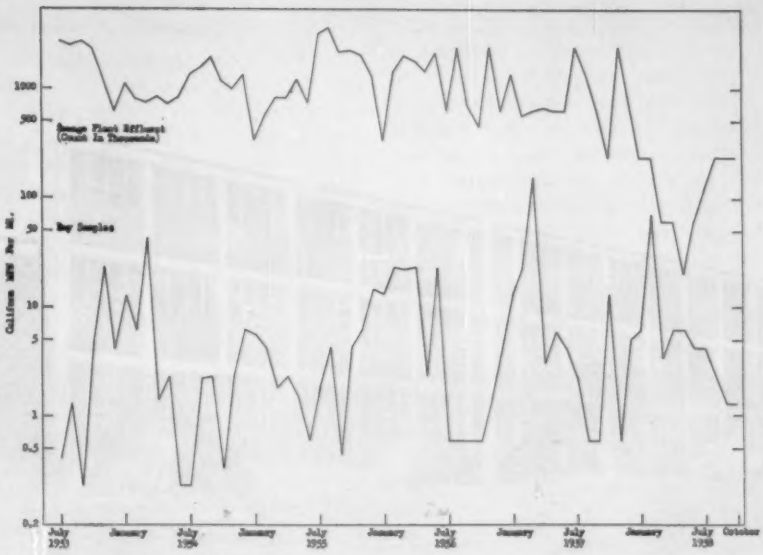



**FIG. 3. MONTHLY MEDIAN coliform counts of sewage plant effluent and of Bay samples July 1953 to October 1958.**

the bacteriological nature of such storm waters. Samples of storm waters from creeks carrying street drainage, from gutters in residential areas, in industrial areas, in commercial areas, and from large storm sewers separated from sanitary sewers were collected from time to time. IMViC testing of colonies from plates prepared from these samples revealed the presence of a wide variety of coliform bacteria. Most of them contained some typical *Escherichia coli* variety 1. Other organisms found included *E. coli* var 2, *Aerobacter aerogenes var* 1, *E. freundii* var 1. One of the samples having a high count and containing typical *E. coli* var 1 was collected from the gutter of a downtown street in a metropolitan area where certainly no sewage was being discharged on the street. Hence, though typical fecal type coliforms are found in storm water, one should not necessarily conclude that the storm water is contaminated with sewage.

An interesting paradox may be inferred from the data in Fig 3. This figure includes a graph of the median value of the coliform count obtained at three Bay sampling stations located about four miles from the outfall sewer and a graph showing the coliform count of the sewage plant effluent during the same period of time. It seems obvious from this figure that when the coliform counts in the Bay were highest, during the winter season, the bacterial counts of the sewage effluent were lowest, and conversely, when the counts in the Bay were low the counts in the effluent were high. If, at this point, all of the other important variables affecting the bacterial quality of receiving waters were neglected and only these variations were considered, the very obviously wrong conclusion might be reached that the way to clean up a receiving body of water is to add a larger volume of sewage effluent. This absurdity, of course, merely illustrates the point that valid conclusions cannot be derived by considering only two of the variables from a complex phenomenon.

The instances mentioned in this paper are only a few of many which illustrate the fact that impressions drawn from the coliform tests may often lead to unwarranted conclusions or to conclusions which are not statistically sound.

In summary, it might be said that before definite conclusions are drawn from coliform data, it is essential that such data result from an adequate, well planned sampling program and that the figures obtained be examined critically.

**References**

1. *Standard Methods for the Examination of Water, Sewage, and Industrial Wastes.* A.P.H.A. New York. 10 Edition, (1955).
2. Zobell, E., *Marine Microbiology.* Waltham, Mass.: Chronic Botanica Co., (1946).
3. Orlob, G. T., Viability of Sewage Bacteria in Sea Water. *Sewage and Industrial Wastes,* **28**:147 (1956).

WATER POLLUTION RESEARCH LABORATORY at Stevenage, Great Britain. (British Crown Copyright Reserved)

Research by a well-known British research laboratory reveals the . . .

# Composition of Sewage and Sewage Effluents—Part 1

by LEO WALTER, Consulting Engr.
and Technical Author
Painswick, Nr. Stroud
Glos., England

■ THE FOLLOWING ACCOUNT is taken from a paper presented to the Institute of Sewage Purification, London, England, by three specialized sewage engineers from the Department of Scientific and Industrial Research, Water Pollution Research Laboratory, Stevenage, Great Britain. This research establishment, shown in Illustration 1, is one of the most progressive in Europe, and it devotes the energy of its scientists and engineers to solving many sewage and sewage effluent problems.

Illustration 2 shows a block of percolating filters where full scale experiments are being performed as part of the research program of the laboratory.

## Experimental Studies

H. A. Painter, M. Viney and A. Bywaters, from the Research Laboratory, made the ensuing investigations.

Samples of sewage and effluents were subjected to a physical separation into fractions of different particle size. These fractions were then examined chemically and the proportions of the major categories of organic substances were determined. Individual compounds in some of these categories have been identified.

Sewage of a purely domestic nature was collected from a sewer serving about 6000 inhabitants of Stevenage New Town. Details of the sewerage system and of strength and rate of flow of the sewage are reported elsewhere[1]. Composite samples, usually 25 gal, were collected over 24-hr, or over an 8-hr period, and each sub-sample was stored at 0 to 2°C to minimize changes. Composite samples of effluents, usually 50 gal, were obtained from laboratory filters and from pilot-scale filters[2] of 16 cu yd capacity, all of

which were treating Stevenage domestic sewage at the rate of 100 gal /cu yd day.

### Fractionation of Samples

To overcome difficulties in sampling suspensions, and to reduce changes brought about by biological action, suspended solids were removed from the samples and analyses were made on the liquid and solids separately. Sewage was given three successive treatments, producing three grades of suspended solids and a filtrate almost free from suspended matter. The sample was first settled for one hr to yield coarse suspended matter. Secondly, the supernatant was siphoned off and centrifuged to yield fine suspended matter. Finally, the liquid remaining was filtered through a porcelain candle, giving ultra-fine suspended matter and a crystal-clear yellow filtrate.

Since the proportion of suspended solids removable only by candle filtration was very small, only two solid fractions were separated. The sample was settled for one hr to yield coarse suspended matter. The supernatant was passed through a continous centrifuge to yield fine suspended matter and an almost clear liquid portion. Finally, the liquid was candle-filtered. The small amount of solids thus obtained was combined with those obtained on centrifuging. All solids fractions were dried under infra-red lamps or were freeze-dried.

### Preparation of Candle-filtered Effluents

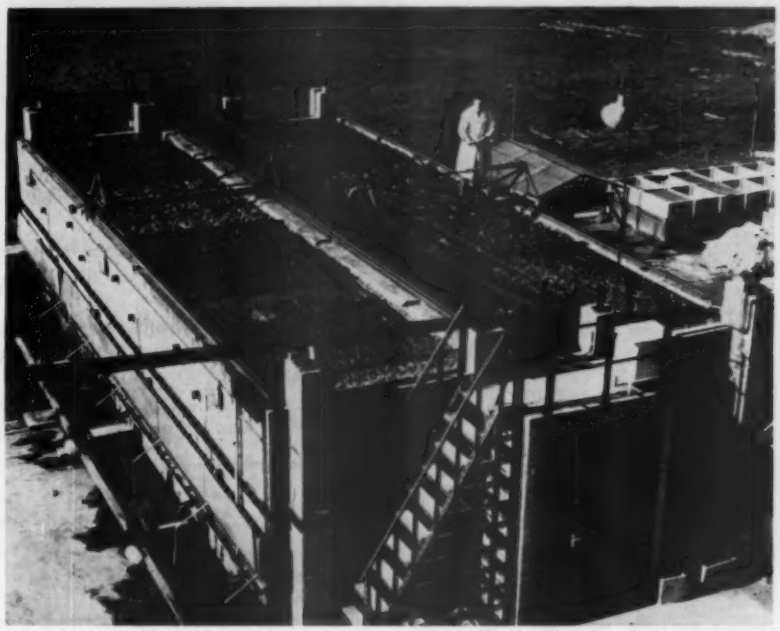
The soluble organic constituents of effluents are individually present in low concentration and are accompanied by a relatively high proportion of inorganic matter. Reduction in volume was brought about by vacume distillation in a continuous-feed cyclone evaporator particularly suited to the evaporation of solutions of heat-sensitive substances. After concentration, about 60 percent of the organic carbon originally present remained in solution, about 10 percent was present in the distillate, and most of the remainder was present in deposited solids. Analyses were carried out on filtered concentrates, after electrodialysis[8] removed interfering inorganic salts (mainly nitrates).

### Analytical Methods

Organic carbon, total nitrogen, ammonia and anionic detergents were determined by standard methods.[4] The values for organic carbon were corrected to exclude that in urea. Volatile fatty acids were determined by double steam distillation at controlled pH value. Non-volatile soluble acids and higher fatty acids were determined by other extractions, followed by titration with aqueous or alcoholic alkali respectively. Fatty esters were determined similarly after the sample had first been hydrolyzed with alkali. All other groups or compounds were determined by colorimetric methods applied directly to the liquid samples, to centrifuged hydrolysates, or to extracts of solid samples. Details of the methods are given in an earlier paper[5]. Muramic acid in hydrolyzed samples of solids was separated from free amino sugars on Celite-charcoal columns[6].

Chromatographic separations were carried out by standard procedures; silica-gel columns were used to separate soluble acids, and higher fatty acids were separated on columns of kieselguhr rendered unwettable[7].

The results of analysis of each fraction are expressed as concentrations in dry solids and also as concentrations in the original sewage or effluent. Since the total weight of organic matter was not known, it was thought that the results could best be expressed as organic carbon. The production of carbon in the various classes was calculated on the assumption that each consisted of one or two known substances; for example, carbohydrates were expressed in terms of glucose, fats in terms of stearic acid, and soluble acids in terms of a mixture of acetic and propionic acids in the ratio 3 to 1.



**EXPERIMENTAL PERCOLATING FILTERS at the Water Pollution Research Laboratory, Stevenage. (British Crown Copyright Reserved)**

## Characteristics of Stevenage Sewage

The strength and nature of the Stevenage sewage are illustrated in Table 1 by the average results of analysis of 24-hr composite samples collected on seven occasions over two years and settled for one hour in the laboratory. Also given are average values for settled sewage applied to the pilot-scale filters for the two months proceding collection of effluents for detailed analysis. This sewage was usually pumped from the sewer during periods of maximum flow and was settled in tanks for about 12 hr before application to filters.

Table 1

**Average values for the strength of settled Stevenage domestic sewage.**

| Sample | No. of samples | 4-hr OA | 5-day BOD | Ammonia (as N) | Organic N | Organic C | Anionic surface-active agent (as Manoxol OT) |
|---|---|---|---|---|---|---|---|
| | | | | (Parts per million) | | | |
| 24-hr composite sample | 7* | 69 | 370 | 46 | 22 | 219 | 24.7 |
| ‡Influent to pilot scale filters§ | 16† | 63 | 291 | 67 | 20 | 159 | 20.0 |

* Collected over 2 years.
† Collected over 2 months.
‡ Settled in cylinders in the laboratory for 1 hr.
§ Settled in tanks for 12 hrs.

Sewage collected over eight hours during the day was stronger than the 24-hr composites (Table 2) by 40 to 50 percent. However, the distribution of organic carbon and organic nitrogen between solids and solutions was much the same for both types of sample—only 28 to 29 percent of the total organic carbon and 37 to 38 percent of the total organic nitrogen were present in solution.

From the data in Table 2 the ratio of BOD to organic carbon for each of the four fractions was calculated. The fine solids brought down by centrifuging and candle filtration (BOD/organic carbon ratios 2.2 and 2.0 respectively) were more readily oxidized in the standard BOD test (without shaking) than the soluble matter (ratio 1.3), which in turn was more easily oxidized than the coarse solids separated by settlement for 1 hr (ratio 1.0).

## Effects of Various Treatments on Settled Sewage

Eight-hour composite samples of fresh whole sewage were fractionated as already described. Samples of settled sewage, obtained by allowing further quantities of the composites to settle for one hr, were subjected to the following treatments, all at 20°C for 16 hr:*

(1) bubbling with air at a rate such that the concentration of dissolved oxygen was 1.5 to 2.5 ppm*

(2) bubbling with nitrogen, to give about the same degree of agitation

(3) standing in a stoppered vessel

* Range typical of local sewer, which carries a relatively low flow.

Standing in a stoppered vessel represented completely anaerobic conditions, while bubbling with nitrogen was introduced to find the effect of agitation with aeration. These experiments were designed to reproduce the extreme range of conditions likely to be experienced by sewage before aerobic biological treatment. After 16 hr, bubbling was stopped and each vessel was gently shaken to mix its contents. Each sample was then separated into four fractions, as described above.

### Results

All three treatments increased the concentration of total suspended solids, though the concentration of suspended matter as determined by the conventional method (Table 3) was not greatly affected. Aeration produced more settleable solids than did either standing or bubbling with nitrogen. A greater proportion of soluble organic carbon was removed by aeration than by the anaerobic treatments, presumably because of

Table 2

**Effect of settlement, centrifuging and candle filtration on the strength of composite samples of whole domestic sewage.**

| Treatment | Sample collected between 6 A.M. and 4 P.M. 4-hr OA | 5-day BOD | Suspended solids* | Organic C | Organic N | 24-hr composite Organic C | Organic N |
|---|---|---|---|---|---|---|---|
| | | | (parts per million) | | | | |
| None | 106 | 663 | 647 (530) | 412 | 35 | 311 | 27 |
| Settlement (for 1 hr) | 95 | 550 | 407 (290) | 302 | 28 | 205 | 21 |
| Centrifuging | 58 | 264 | 117 ( 0) | 172 | 19 | 137 | 15 |
| Candle filtration | 49 | 157 | 0 | 118 | 13.5 | 91 | 10 |

*The values include matter in very fine suspension removable only by candle filtration and not determined by the standard centrifuging method. The values obtained by the latter method are given in brackets.

Table 3

**Effects of aerobic and anaerobic treatment on distribution of organic carbon between suspended solids and solution in settled sewage.**

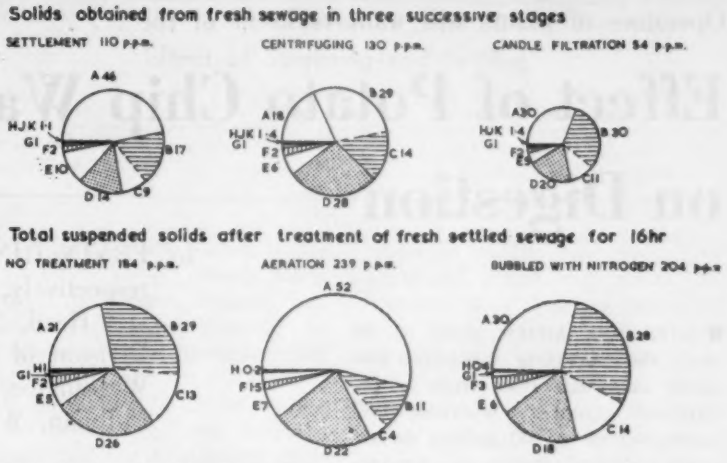
| Component | Settled sewage after following treatment None | Aeration | Agitation with nitrogen | Quiescent standing |
|---|---|---|---|---|
| | | (Parts per million) | | |
| Solids removed by: | | | | |
| A Settlement | — | 127 | 81 | 83 |
| B Centrifuging | 130 ( 43) | 6 | 45 | 30 |
| D Candle filtration | 54 ( 18) | 106 | 78 | 88 |
| Suspended solids* (A + B) | 130 | 133 | 126 | 113 |
| Total suspended solids (A + B + D) | 184 | 239 | 204 | 201 |
| Candle filtrate | 118 ( 39) | 32 | 103 | 104 |
| Whole sample | 302 (100) | 271 | 307 | 305 |

*As determined by standard method.
Figures in brackets are percentages of total carbon.

the formation of more suspended solids and carbon dioxide by aerobic bacterial action.

The composition of suspended solids from whole, fresh sewage (as proportions of the total carbon content of each fraction) are shown in Illustration 3a. The organic nitrogen content increased and the C/N ratio decreased with decreasing particle size. In all three fractions fats, proteins and carbohydrates were the main identified constituents, with fats predominating, and together these groups accounted for well over half of the organic carbon. The other five groups determined contributed altogether less than five percent of the total organic carbon. The carbohydrate content decreased with particle size but the hexose/pentose ratio was fairly constant for the three fractions.

Aerobic and anaerobic treatments of settled sewage resulted in increases in the organic nitrogen content and reduction of the C/N ratio of all three grades of suspended solids. Determinations of individual groups in total suspended matter (Illustration 3b) showed that the anaerobic treatment produced little change in composition. Aeration, however, resulted in a marked decrease in the proportion of fats, both acids and esters, and greatly increased the proportion unaccounted for. The fat content of candle-filtered solids derived from all treatments was much less than that of the corresponding fraction in fresh sewage.


(a) Solids obtained from fresh sewage in three successive stages
SETTLEMENT 110 p.p.m.
CENTRIFUGING 130 p.p.m.
CANDLE FILTRATION 54 p.p.m.
(b) Total suspended solids after treatment of fresh settled sewage for 16hr
NO TREATMENT 184 p.p.m.
AERATION 239 p.p.m.
BUBBLED WITH NITROGEN 204 p.p.m.

**COMPOSITION OF SUSPENDED SOLIDS as proportions of the total carbon content.**

**a) Solids obtained from fresh sewage in three successive stages.**

**b) Total suspended solids after treatment of fresh settled sewage for 16 hours.**

## Review Of Taste And Odor Offered

The Franklin Institute of Philadelphia is offering a report of the study conducted on Taste and Odor in Water, which is being sponsored by the Manufacturing Chemists' Association, Inc.

A Critical Review of the problems and a selected accumulation of known facts about the subject was written by Robert A. Baker.

The report, F-A2333, deals with the first phase of the research project and may be obtained from the Manufacturing Chemists Association, Inc., 1825 Connecticut Ave., Washington 9, D. C.

## Flood Frequency in New York

A report is available on the frequency and magnitude of floods in New York State. The study was made by the Geological Survey and the State Department of Public Works.

Survey data provide a means of estimating the peak discharge of a stream for once in 1.1 to once in 50 years. Estimates can now be made for any site in New York where the drainage area is 10 square miles or more.

The report, entitled "Floods in New York, Magnitude and Frequency," by F. Luman Robison, is published as Geological Survey Circular 454. Copies are available free from the Director, U. S. Geological Survey, Washington 15, D. C.

## Dr. Wm. Stericker Receives Award

Dr. Wm. Stericker, formerly Development Chemist and presently Consultant with Philadelphia Quartz Company, manufacturers of soluble silicates, was presented a distinguished service award by the American Chemical Society, Division of Water & Waste Chemistry.

The award for constructive participation in the activities of the Division for many years was presented to Dr. Stericker on September 5 at the Division dinner at the National ACS Metting in Chicago. Dr. Stericker has been active in water chemistry and has served ACS as Chairman of the Water & Waste Division.

### ERRATA

United States Patent No. 2,997,-284, shown in Chicago Pump's advertisement of its new Model 30 Swing Diffuser in the October issue of this magazine, was an erroneous citation. Patent No. 2.997,284 refers to a model of swing diffuser equipment not illustrated in the advertisement. The model illustrated is covered by pending applications for patent.

## Minneapolis-Saint Paul Sewage Report

The Twin City sewage treatment plant reported its 22nd full year of operation with the costs of operation and maintenance, including capitalized improvement changes, as $1,-205,853.97 compared to $1,321,097.47 of the year 1960.

Aside from this decrease in expenditures, one noteworthy item was recorded. Out of 93 employees, there were 32 whose length of service ranged from 20 to 27 years.

Operators of plants will want to know of the . . .

# Effect of Potato Chip Wastes on Digestion

by ERVIN HINDIN and G. H. DUNSTAN
respectively, Assistant Sanitary Chemist and Head, Sanitary Engineering Section
Division of Industrial Research
Washington State University
Pullman, Wash.

■ WITHIN A SHORT SPAN of 30 years, the processing of potatoes into potato chips has risen from an insignificant venture to where in 1959 it represented a 500 million dollar-a-year industry[1]. Potato chip production ranks today as one of the giants of the food processing industry.

In 1959, in excess of 4 lbs of potato chips, equivalent to 17 lbs of fresh potatoes, were consumed per capita. This value is an increase of more than 200 percent in ten years. The conversion of potatoes into chips is becoming important in the agricultural economy of certain areas of this country. One out of every seven potatoes grown for human consumption was converted into potato chips or about 47.5 million bushels of potatoes were utilized in making this product in 1959[2].

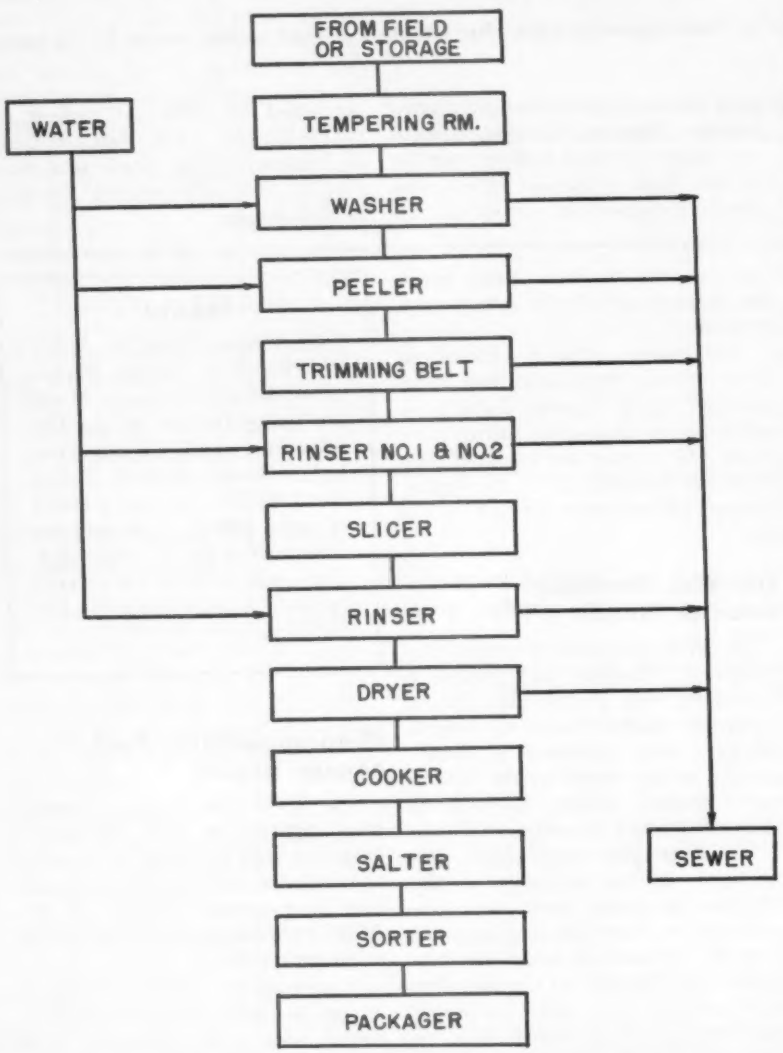



Fig. 1. FLOW DIAGRAM of typical potato chip processing plant.

## Plant Operation

Basically, production operations in all plants are similar. Fig. 1 represents a flow diagram of a typical potato chip making process.

Potatoes are sent to the plant from storage areas. Prior to processing potatoes into chips, potatoes are tempered at 70-75°F for a period of five to six weeks. After tempering, the potatoes are washed with high rate sprayers to remove the dirt. In this operation, sprouts, if present, are detached and decayed potatoes are washed away. The potatoes are conveyed to a peeler, where the potatoes are peeled by use of high speed abrasive rollers and the peels are removed by a water spray. The potatoes are then trimmed, rinsed, sliced, rinsed again, dried, cooked, sorted and packaged. The washer and peeler waste water are directly sewered while the trimmer wastes, rinse waters, and drier waste waters are combined and ground prior to being sewered.

## Disposal

Approximately 250 lbs of potato chips are produced from 1,000 lbs of potatoes. The water required to process 1000 lbs of potatoes will vary from 1,450 to 2,480 gals. The

suspended solids produced from processing 1000 lbs of potatoes ranges from 20.4 lbs to 36.4 lbs[3]. Such suspended solids comprise peels, starch, grit, and ground potato fragments including sprouts and decayed matter. The quantity of suspended matter in the waste water resulting from the potato chip making process will vary depending upon the variety of potatoes used and plant practices; ie whether or not the solid matter is screened or settled out of the waste water prior to disposal.

The method of disposal commonly employed by plants in urban centers is to discharge the wastes into the municipal sewer system for treatment with domestic sewage at the sewage treatment plant. It has been estimated that approximately 75 tons of potato chip waste solids were discharged into the nation's municipal sewer systems in 1959[2].

A high degree of separation of the waste solids from the liquid can be achieved by settling. The removal of the solids by screening and settling is shown in Table 1[2].

Virtually all of the settleable solids and about 96 percent of the suspended solids are removed by the conventional settling equipment at the sewage treatment plant. The settled matter is sent to the digesters to be decomposed anaerobically. The liquid portion of the potato chip waste can be treated satisfactorily by the conventional aerobic methods.

Periodically, adverse effects on the anaerobic digestion of raw sewage sludge due to abnormal amounts or a drastic change in quality of the potato chip waste have been noted at the Tacoma, Washington, sewage treatment plant[4]. As a result a study was undertaken to determine the compatibility to anaerobically digesting potato chip waste settled solids with that of domestic raw sludge.

### Procedure

The experimental apparatus and the procedure for starting up a laboratory scale digester were described in an earlier paper[5]. Four digesters were started simultaneously under similar conditions. After the digester had reached dynamic equilibrium, the digesters were paired. One set served as the control, while the other set was fed a mixture of potato chip waste settled solids and domestic raw sludge.

Table 1

**Effect of Screening and Settling**

| | To Vibrating Screen | To Settling Basin | From Settling Basin after 3 hrs |
|---|---|---|---|
| Suspended Solids mg/l | 5910 | 3350 | 226 |
| Settleable Solids ml/l | 270 | 26 | trace |

The digesters were loaded at the rate of 0.075 lbs of volatile solids per cu ft of digester capacity per day and a detention time of 33 days was maintained throughout the study.

The supernatant displaced by the addition of the feed was collected and examined for its chemical characteristics. The digester gas was collected in a brine displacement type gasometer and quantitatively and qualitatively measured. Digester sludge samples were withdrawn weekly for measurement of their volatile solids content. All methods of analysis were according to Standard Methods[6] except the separation and determination volatile acids[7, 8].

### Digester Feed

The digesters serving as controls were fed raw sludge. The test digesters were fed mixtures consisting of varying amounts of potato chip waste, settled solids and raw sludge. The raw sludge consisted of solids settled from domestic sludge sewage combined with the cellular matter sloughed off of a high rate trickling filter. The potato chip waste solids consisted of the settled solids from the washer and peeler wastes and the combined ground wastes from the trimming, slicing, and rinsing operatons. Each lot of raw sludge and potato chip waste settled solids was analyzed for its total and volatile solids content. Analysis of some of the important chemical constituents of the wastes is presented in Table 2. The values shown are based on a series of monthly composite samples of the dried wastes.

Analysis of the raw sludge and pasteurized potato chip waste, refrigerated at 4°C for a period of seven days, showed little or no change in their chemical indices.

### Discussion

The digesters were started in the conventional manner, using raw domestic sludge as the feed. After fermentation had reached dynamic equilibrium, the feed of the test units was changed to a mixture containing 1 percent of potato chip waste solids, by volatile weight, in domestic raw sludge. Following reestablishment of dynamic equilibrium, the effect of the presence of potato chip waste on the various products of digestion was determined. With the termination of the investigation period the feed was changed to contain a greater quantity of potato chip waste solids. This same scheme was followed in determining the effect of feeds containing 5, 10, 25, 50 and 75 percent potato chip waste in domestic raw sludge on the digestion process.

The data presented in Table 3 are average values of the chemical indices examined. The duration of the investigation period at a specific feed mixture was a minimum of 5 weeks.

There was no significant difference in the quantity of gas produced between the test and control digesters for the various concentrations of potato chip wastes in the feed; however, there was a noticeable change in the composition of the gas. With an increase in the quantity of potato chip waste in the feed, a decrease in the relative quantity of the hy-

Table 2

**Chemical Composition of Wastes**

| | Potato Chip Waste-Settled Solids | Sewage Solids |
|---|---|---|
| Total organic nitrogen as N | 1.002 % | 4.10 % |
| Carbon as C | 42.2 | 43.3 |
| Total phosphorous as P | 0.0830 | 0.406 |
| Total sulfur as S | 0.0825 | 0.462 |
| Volatile Solids | 95.2 | 76.1 |

**Table 3**

**Experimental Data**

| Feed | | | | | | |
|---|---|---|---|---|---|---|
| % Potato Chip Waste Solids (% by V.W.) | Control | 1 | Control | 5 | Control | 10 |
| Carbon-Nitrogen Ratio C/N | 10.6:1 | 10.6:1 | 10.6:1 | 10.6:1 | 10.6:1 | 11.3:1 |
| % Volatile Solids in Feed | 77.4 | 77.6 | 71.5 | 72.8 | 78.6 | 80.5 |
| Gas | 6.92 | | | | | |
| Gas Production Cu. ft/lb. Volatile Matter/Day | 6.92 | 7.02 | 7.99 | 7.40 | 7.77 | 7.49 |
| % $H_2S$ group | 5.9 | 6.5 | 5.2 | 7.1 | 6.3 | 4.4 |
| % $CO_2$ group | 29.1 | 31 | 32.0 | 29.31 | 29 | 32.3 |
| Supernatant | | | | | | |
| pH | 7.58 | 7.52 | 7.66 | 7.51 | 7.77 | 7.61 |
| Alkalinity mg/l. $CaCO_3$ | 4632 | 4379 | 4752 | 3979 | 5083 | 4352 |
| Ammonia Nitrogen mg/l. | 1397 | 1402 | 1275 | 1062 | 1361 | 1200 |
| 5 Day B.O.D. mg/l. 02 | 1512 | 2152 | 814 | 1363 | 636 | 928 |
| Total Volatile Organic Acids mg/l. Acetic Acid | 725.9 | 1045.3 | 180.3 | 390.3 | 391.5 | 667.3 |
| % Butyric Acid group | 9.49 | 10.60 | 7.59 | 9.39 | 9.98 | 11.89 |
| % Propionic Acid group | 26.09 | 22.69 | 16.66 | 31.02 | 20.29 | 30.19 |
| % Acetic Acid group | 63.09 | 65.55 | 67.57 | 55.76 | 66.04 | 55.79 |
| % Formic Acid group | 0.73 | 0.60 | 3.94 | 11.83 | 2.24 | 0.87 |
| % Lactic Acid group | 0.60 | 0.56 | 4.24 | 2.00 | 1.45 | 1.26 |
| Digested Sludge | | | | | | |
| % Volatile Solids in Sludge | 50.3 | 50.2 | 47.7 | 47.4 | 49.0 | 49.8 |
| Digester Efficiency | | | | | | |
| % Reduction of Volatile Solids Added | 7.16 | 71.7 | 63.5 | 66.0 | 73.8 | 76.7 |

drogen sulfide group of gases and an increase in carbon dioxide resulted.

The most significant changes occurred in the supernatant. The alkalinity of the test units decreased as the potato chip waste in the feed increased. It was not until the digesters were fermenting a mixture containing 75 percent potato chip waste that the alkalinity becomes less than 2000 mg/l as $CaCO_3$.

Ammonia nitrogen is the most important cationic constituent of the buffering system. The quantity of carbon dioxide in the gas is dependent on the buffering system. The gas producing bacteria rely on ammonium salts as their source of nitrogen. Buswell in an earlier work indicated that ammonia nitrogen must be in excess of 400 mg/l as N to insure active digestion[9]. The ammonia nitrogen decreased as the potato chip waste content in the feed increased; however, the ammonia nitrogen concentration did not approach 400 mg/l until the digesters were fermenting a mixture containing 75 percent potato chip waste.

An important index of digestion, one used to indicate current digester conditions, is the total volatile organic acids. It has been shown by a number of investigators that when the acid content exceeds 2,000 mg/l as acetic acid, gas production decreases [10, 11]. As the quantity of potato chip waste solids in the feed increased so did the volatile organic acids, yet at no time in the study had the volatile organic acids exceeded 1,400 mg/l as acetic acid.

A previous study conducted by the authors for the purpose of determining some aspects of sludge digestion, at detention time and loading identical to this study, revealed that during optimum digestion, the butyric-propionic-acetic acids ratio should be approximately 10-25-63[10]. The relationship of the three major acids found in the control were within the 10-25-63 range. The ratio did not apply when the digesters were fermenting mixtures containing an excess of 1 percent potato chip waste. The relative quantity of butyric acid increased with an increase of potato chip waste in the feed. Butyric acid was in such high concentrations that it imparted a rancid odor to the digester gas as well as the supernatant. The relative quantity of propionic increased as the percent of potato chip waste in the feed increased, reaching a maximum when a mixture containing 25 percent potato chip waste was being fermented. Thereafter the relative quantity of propionic acid decreased to where there was no significant difference between the control digesters and the test units fermenting a mixture containing 75 percent potato chip waste. The relative quantity of acetic acid in the supernatant decreased with increased potato chip waste in the feed.

The 5 day BOD of the supernatant from the test digesters increased as the percent of potato chip waste in the feed increased. The increase was primarily due to the increased amount of intermediate organic products, ie, volatile acids. The difference in the pH between the test and control digesters was insignificant. However, there was a sharp decrease when the digesters were fermenting a mixture containing 75 percent potato chip waste. The decrease indicates that the system was beginning to come under stress.

There was no significant difference in the percent of volatile matter found in the digested sludge from the control and the test digesters throughout this study. One factor must be considered, the volatile solids content of the feed in the test digesters increased as the percent of potato chip waste in the feed increased.

The most important criteria of digestion is its efficiency in stabilizing the volatile solids in the waste. There was no significant difference between the efficiency of the control digesters and of the test units fermenting mixtures containing 25 percent or less potato chip wastes in the feed. There was a significant increase in the efficiency of the test units when digesting mixtures containing 50 percent or more potato chip wastes in the feed.

An investigation was undertaken to determine the effect of a sudden

Table 3

Experimental Data

| Feed | | | | | | |
|---|---|---|---|---|---|---|
| % Potato Chip Waste Solids (% by V.W.) | Control | 25 | Control | 50 | Control | 75 |
| Carbon-Nitrogen Ratio C/N | 10.6:1 | 12.9:1 | 10.6:1 | 16.7:1 | 10.6:1 | 23.8:1 |
| % Volatile Solids in Feed | 78.8 | 83.2 | 76.1 | 85.1 | 77.9 | 91.5 |
| **Gas** | | | | | | |
| Gas Production cu ft/lb volatile matter/day | 7.59 | 7.31 | 7.50 | 7.56 | 7.55 | 7.71 |
| % $H_2S$ group | 6.3 | 3.8 | 7.2 | 6.4 | 6.4 | 3.8 |
| % $CO_2$ group | 30.8 | 34.5 | 28.4 | 27.9 | 27.9 | 39.7 |
| **Supernatant** | | | | | | |
| pH | 7.59 | 7.34 | 7.73 | 7.64 | 7.64 | 6.74 |
| Alkalinity mg/l $CaCO_3$ | 4533 | 3662 | 4327 | 2936 | 4419 | 1855 |
| Ammonia Nitrogen mg/l N | 1302 | 994 | 1339 | 721 | 1440 | 480 |
| 5 Day B.O.D. mg/l $O_2$ | 1534 | 1646 | 489 | 1870 | 1457 | 3169 |
| Total Volatile Organic Acids mg/l Acetic Acid | 593.5 | 1042.1 | 416.6 | 1209 | 631 | 1363 |
| % Butyric Acid group | 12.97 | 16.55 | 16.80 | 27.83 | 15.60 | 39.5 |
| % Propionic Acid group | 23.94 | 30.65 | 26.00 | 26.72 | 20.79 | 23.24 |
| % Acetic Acid group | 59.5 | 51.40 | 54.75 | 42.64 | 62.20 | 36.58 |
| % Formic Acid group | 2.43 | 0.83 | 1.31 | 1.51 | 0.72 | 0.33 |
| % Lactic Acid group | 1.16 | 0.57 | 1.14 | 1.30 | 0.69 | 0.33 |
| **Digester Sludge** | | | | | | |
| % Volatile Solids in Sludge | 46.7 | 55.3 | 56.2 | 48.6 | 57.5 | 46.9 |
| **Digester Efficiency** | | | | | | |
| % Reduction of Volatile Solids Added | 75.9 | 74.9 | 70.3 | 83.3 | 62.4 | 92.1 |

change of composition of the feed. This was done by feeding one of the controls a mixture containing 75 percent potato chip waste solids without gradually acclimatizing the digesters. Difficulty was obtained in restoring the dynamic equilibrium.

## Conclusion

This study has shown that mixtures of potato chip wastes in raw sludge containing as high as 50 per cent potato chip waste can be satisfactorily treated. The digestion process showed signs of stress when fermenting mixtures containing 75 percent potato chip wastes. The stress was due to a nutritional deficiency. Supplementation with ammonium and phosphate salts are recommended to bolster the capability of the digester to withstand any abnormalities in digester operation or changes in composition of the feed. Digesters decomposing raw sludge containing no abnormal amount of carbohydrate material must be gradually acclimatized to be able to ferment potato chip waste solids.

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## Information on Research Grants Available

The Public Health Service has available a booklet about opportunities for research entitled "Research Grants in Environmental Health in the Public Health Service."

The booklet is intended to acquaint scientific researchers with new and expanded opportunities for research and training in the area of environmental health; including air pollution, water supply and pollution control, radiological health, occupational health and industrial hygiene, and environmental engineering and food protection.

The booklet may be obtained from the Office of Resource Development, Bureau of State Services, U. S. Department of Health, Education, and Welfare, Washington 25, D. C.

## PVC Plastic Pipe Standards

Standard dimensions for lightweight PVC plastic pipe have been adopted by the industry. They have just been published by the Commodity Standards Division, Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

The Standard was developed with the cooperation of interested manufacturers, distributors and users, in line with a proposal by The Society of the Plastics Industry, Inc.

The new standard covers outside diameters and tolerances; minimum and maximum wall thicknessess; inspection procedures; and identification markings for 11 sizes of rigid lightweight polyvinyl chloride pipe.

The edition, Commercial Standard, CS237-61, *Dimensions and Tolerances for Schedule A Type I and Schedule A Type II Rigid Polyvinyl Chloride Pipe*, may be purchased from the U. S. Government Printing Office, Washington 25, D. C. for 5 cents.

NATIONAL CLAY Pipe Manufacturers, Inc., Research Laboratory.

# Clay Pipe Industry Research

by A. J. REED
Research Director
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Crystal Lake, Ill.

■ THE SUBJECT of research is a fascinating one that has captured the public fancy in the past fifteen years. Prior to World War II, the cost of research in most companies and industries was considered to be an unnecessary expense, even a gratuity. In recent years, this type of thinking on the part of management has changed drastically. The American people have become accustomed to reading about the accomplishments of research almost daily in the newspapers and magazines. The public concept of research is usually based on the accomplishments in the more glamorous fields of electronics and missiles. However, the research accomplishments in less glamorous fields are no less important to the American public.

In the past fifteen years, a great deal of research money has been spent in the fields of public health and sanitation. Stream pollution and air pollution have become very serious problems. Recently, the so-called population explosion has received a great deal of publicity. The industrial growth of this country is also proceeding at a tremendous rate. All of these factors have combined to present an unprecedented challenge to those companies, individuals and organizations concerned with the products and problems associated with public health and sanitation.

## Research Program Growth

Nearly 20 years ago the first concerted effort was begun by the vitrified clay pipe industry to deal with these problems. In 1943, the National Clay Pipe Research Corporation was formed by approximately 20 companies manufacturing vitrified clay pipe. The objective of this organization was to conduct fundamental and engineering research on vitrified clay pipe and its function as a sanitary piping material. Three years later, in 1946, the Research Division of National Clay Pipe Manufacturers, Inc. was formed with the objective of conducting research on the end use problems in the vitrified clay pipe industry.

This research was conducted both by contract with independent laboratories and in the industry research laboratory in Los Angeles, California. Both of these research efforts within the industry expanded in the ensuing years until, in 1958, the industry constructed a new research laboratory in Crystal Lake, Illinois. Two years later, both organizations were merged into one, resulting in a further expanded, more concentrated effort on research in the field of sanitary piping materials.

The present research division of National Clay Pipe Manufacturers, Inc. represents 37 companies in the United States producing approximately 90 percent of the vitrified clay pipe in this country. In addition to the research being done in the Crystal Lake, Illinois, laboratory, outside contract research is conducted on specialized problems in various research organizations throughout the United States. Current research projects are divided approximately equally between end use research and engineering or fundamental research.

VIEW OF JOINTING materials laboratory.

## Applied Research

### Backfill Loading Studies

One of the important current projects from an end use standpoint involves studies of loads and stresses that are carried by the pipe and jointing materials as a result of non-uniform backfill loading. These non-uniform loads are usually caused by improper laying practice. The strain gauge technique is being used in these studies as a method of determining the effect of various types of bedding and various types of backfill on the load bearing characteristics of the pipe and joint. The data obtained from this study will be used as an aid in the selection of new jointing materials and the development of new jointing designs. Also, through the use of load cells, further information will be developed on the uniformity of loading as a function of bedding, depth and type of backfill.

### Jointing Materials

Chemical resistance studies of both sanitary piping materials and jointing materials are a source of constant research in the laboratory. In the research on jointing materials, the primary requirement is that the jointing material have chemical resistance characteristics which approach those of the vitrified clay pipe itself. In the manufacturing process, vitrified clay pipe is fired in either continuous or periodic kilns to approximately 2000°F in order to render it completely inert. The only known chemical substance which will deteriorate a vitrified clay body is hydrofluoric acid, the acid used to etch glass. Since a vitrified clay body is internally bonded with a network of glass, hydrofluoric acid is the only substance that will attack it. This acid is seldom, if ever, found in sanitary or industrial type wastes. Because of the inertness of vitrified clay, the selection of jointing materials becomes somewhat difficult in order to obtain the physical and chemical resistance requirements comparable to the pipe itself.

In recent years a great deal of research time and money have been spent on the development of compression type joints for vitrified clay pipe. Since the life expectancy of the joint must approach that of the pipe, compression is the most reliable premise upon which a joint may be designed. A properly designed compression type joint utilizing top grade resilient materials can be expected to perform indefinitely under compression at the pressures for which it was designed. In the selection of jointing materials, therefore, physical characteristics are as important as chemical resistance characteristics.

The principle materials being used in compression type joints currently are vinyl chloride plastisols, polyester resins, natural rubber and neoprene. Two newer materials that are finding growing acceptance are epoxy type resins and polyurethanes. All of these materials have been thoroughly tested during the stages of their development for their physical and chemical properties before becoming commercial products.

All jointing materials in commercial use undergo long-term sewage exposure tests in various sewage disposal plants throughout the United States. Some of the materials currently being used in the jointing of vitrified clay pipe have been exposed to flowing sewage and potent sewage atmospheres for periods of time up to 10 years.

### Flow Characteristics

Another major project, recently completed, involved a study of the flow characteristics of various types of sanitary piping materials at different grades and depths of flow. These flow characteristics, more commonly known as the coefficient of friction of flow, or Manning's "n", have been a source of considerable discussion in recent years. The objective of this two year project was to determine the differences in Manning's "n", if any, among the various types of sanitary piping materials. In the course of this study, over 2000 individual determinations of Manning's "n" were made under various conditions of depth of flow and grade with several types of sanitary piping materials. It was found that there was no significant difference in Manning's "n" under these various conditions which might be attributed to the surface characteristics of the material under test.

Several other factors have been found to have a much greater controlling effect on Manning's "n".

**LOAD BEARING TESTS being conducted on vitrified clay pipe using strain gauge technique.**

**VITRIFIED CLAY pipe compositions being tested at 2000°F.**

Some of these controlling factors are: 1. quality of workmanship in laying the line, particularly with respect to line and grade, 2. size of pipe, depth of flow and grade, 3. resistance of the surface of the piping material to abrasion after an extended period of service. The number of joints in the line had no significant effect on Manning's "n" in these field tests conducted under highly controlled conditions. However, a major contributing factor to uniform flow coefficient properties may be the effect of abrasion on the surface of the piping material. This abrasion may become critical over an extended period of time, thus reducing the carrying capacity of the line. Consequently, abrasion tests are currently being made on various types of sanitary piping materials to study this possibility.

## Fundamental Research

### Materials and Methods

In addition to the above discussed end use research projects, the clay pipe industry research program includes several projects of a fundamental nature. Among these is a study of the mineralogical structure of clay pipe bodies with the objective of further increasing the strength of the pipe itself. In the past, this project has been studied on a contract basis in various universities and independent research organizations. However, the industry laboratory is now being expanded in order to undertake this work. Research is also being conducted on electronic methods of controlling clay consistency during extrusion in the manufacturing process. Also, new methods are being studied to mechanically and automatically manufacture all types of clay pipe fittings.

All of these projects are directed toward one objective: To further improve the quality of the product and its performance as a sanitary piping material.

The money being spent on research on an industry basis has been quadrupled in the past 14 years. In addition to the industry research program, individual companies are conducting their own research programs independently. Only through this type of progressive thinking and advancement, can the challenge be met to solve the problems of sanitation and public health that face us during the next 25 years.

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## K. L. Murphy Moves From University Of Wisconsin To McMaster University

Keith L. Murphy has been named Assistant Professor of Civil Engineering and Engineering Mechanics at McMaster University, Hamilton, Ontario. In this position he will be responsible for developing the laboratory and academic program in sanitary engineering, both at the undergraduate and graduate levels. Dr. Murphy received his B.A.Sc. from the University of Toronto in 1954. His M. Sc. was received in 1959 from the University of Wisconsin, and his Ph.D. in 1961, also from the University of Wisconsin. In addition to his studies in Wisconsin, Dr. Murphy was an instructor in Civil Engineering and a Project Associate for the Experiment Station. Previous employment was with the City of Hamilton and then by the Greater Winnipeg Water and Sanitary Districts.

## William C. Gibson, U. of M, Dies at 46

William C. Gibson, associate dean of the University of Michigan School of Public Health, died August 17 at the U of M Medical Center after an illness of several months. He was 46.

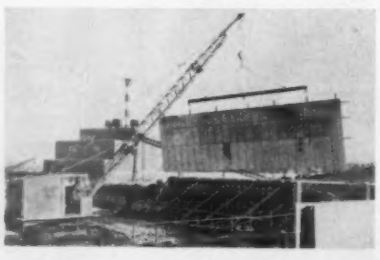
A graduate of New York University (1936) and the University of North Carolina (1950), Gibson attained international prominence in the field of public health engineering. He was appointed associate dean at the U of M in January, 1961.

## Pouring A Minnesota Fire Wall

Gang forming prefab forms proved to be a "natural" way to pour concrete for a fire wall at the Fox Lake Station of Interstate Power Co. at Sherburn, Minn.

Fuel Economy and Engineering Co. decided on this method after confering with a Symons Clamp technical representative.

They used 5,000 sq ft of forms, assembled together in 45 by 13 ft sections for the walls which were battered from 16 in. at the bottom to eight at the top, with joints every 45 ft.



Five men on the job plus a crane were able to assemble the forms and set them up in 70 minutes and handle all the erection and stripping.

A total of 40,000 sq ft of forming was required to pour the walls which were a rectangle 440 by 180 ft to enclose two 55,000 barrel fuel oil tanks.

## "More" Water For San Bernardino, Calif.

The people of San Bernardino, Calif. are keeping close tabs on the water filtering system installed a few weeks ago at the Five-Minute Car Wash.

The automatic recording pen of the meter mounted on the filter is helping spell out the answer to the problem of where to find water to fill the city's increasing household industry and municipal needs.

The water used in washing cars is filtered, then re-used. Readings indicate 70 percent water savings. Daily gallonage drawn from the city mains has dropped from 15,000 to about 4,600.

Following a survey by a team of engineers, William O. Baker, head of Baker Filtration Company of El Monte, recommended a series of practical filtering system tests in various San Bernardino businesses, with the car wash installation the first. The company installed the new filter after approval.

Unqualified management support has been assured the additional tests, Mayor Donald Mauldin said, which will be at other major water users such as dairies, laundries and food processing plants.

"We stand to cash in on several bonuses by utilizing filtering systems to multiply our supply of water," he said. "First, there's the extra water. Second, there's a money saving."

# Water Utility Distribution Loss

## Part 4

EDITORS NOTE: This article concludes a series on water quantity accounting. It outlines the problem, discusses the utility system generally and the utility distribution system specifically. Predicated on complete metering and systematized accounting, the method is adaptable to machine accounting procedures. Staggering national distribution system loss, estimated at $50 million per year for operating costs alone, is well worth studying and correcting.

by DALE E. SMELSER
Knoxville, Tennessee

■ THE SUCCESS of a loss control program will to a great extent depend on the accuracy and constancy of reporting all losses—the compilation of all pertinent information required for a study of the contributing factors—and finally, from this information, initiate means for correction. To accomplish this the author has developed a "Water Accounting-Uniform System of Accounts" patterned after the Uniform System of Accounts prescribed for Public Utilities by the Federal Power Commission.[18]

The term "unaccounted-for-water" as used by the average utility is a misnomer, because it represents the difference between the water delivered to the distribution system and that sold, plus a few estimated items such as fire uses, etc. The figure is commonly expressed as a percentage and is usually around 15 percent of the water input to the system. A notable exception is Pasadena, California, where the water consuming elements of the operation are itemized resulting in a true figure for unaccounted water. This quantity was 2.017 percent of production in 1940. On a per capita per day basis the production (Di) was 173 gpcd and the losses (DL), 16.6. The unaccounted for quantity which is included in the total losses was 3.5 gpcd. This is indeed a commendable record, and, as previously stated, can well be used as a performance criterion. Any water utility of comparable size (1940 pop. 81,864) can profit by a study of the twenty items of loss as listed by Pasadena. (See Table 4, part 3.)

In conjunction with this accounting system, some of the basic records used by the average utility and adequately described in the AWWA, Recommended Practice for Distribution System Records, AWWA C 900-40, may be utilized, such as:

1. Leak frequency map
2. Leak report form
3. Leak survey district map
4. Water gradient contour map

In order to insure close liason between departments a Water Used Report may be provided in pad form with white original and pink copy. A pad of these forms is to be given all construction and service crews. When water is used in the field it will be reported to the office on the original, retaining the pink copy in the pad. A partial list of suggested items for this form is:

**Water Used Report** **Date**

| Testing Mains | Flushing Mains | Sterliving Mains | Backfilling |
|---|---|---|---|
| Location | Location | Location | Location |
| Dia. of pipe | Size of opening | Water used | Water used |
| Length of pipe | Residual psi. during flow | | |
| Number of joints | Duration of flow in minutes | | |
| Pressure psi. | Water used | | |
| Kind of pipe | | | |
| Water used | | | |

The water used form is intended for use by the construction and maintenance crews to report losses not included in other forms, such as hydrant test, etc.

### Distribution System Districts

A distribution system of the size considered in this study will secure the best results by dividing the sys-

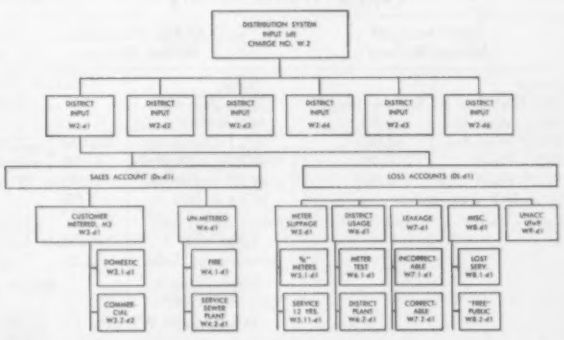


FIG. 8. WATER QUANTITY ACCOUNT flow sheet for distribution districts.

**Table 7**
**Dallas Water Billing, 1954-55*[a]**

| Accounting Code | Class of Consumer | Number of Accounts: District 99 | Districts 1-21 | Total | Percent of Total | Quantity of Water Billed: District 99 mil gal. | Dists. 1-21 mil gal. | Total mil gal. | Percent of Total |
|---|---|---|---|---|---|---|---|---|---|
| A | Single family or duplex dwelling (See J & K below) | 14 | 138,251 | 138,265 | 88.99 | 12.9 | 13,351.9 | 13,364.9 | 58.42 |
| B | Commercial and small industrial | 294 | 12,273 | 12,567 | 8.09 | 1,424.7 | 3,186.8 | 4,611.5 | 20.16 |
| C | Churches & non-profit institutions | 22 | 662 | 684 | 0.44 | 223.3 | 158.8 | 382.1 | 1.67 |
| D | Rental: Apartments, projects, authorities | 29 | 1,716 | 1,745 | 1.12 | 605.0 | 682.6 | 1,287.6 | 5.63 |
| E | Food processing and bottling, large | 33 | 13 | 46 | 0.03 | 702.3 | 13.8 | 716.0 | 3.13 |
| F | Public authority, other than City of Dallas | 51 | 3 | 54 | 0.04 | 190.2 | 0.9 | 191.0 | 0.83 |
| G | City of Dallas, all installations | 9 | 59 | 68 | 0.04 | 18.0 | 33.2 | 51.2 | 0.22 |
| H | Public schools | 161 | —— | 161 | 0.10 | 172.5 | 0.4 | 172.8 | 0.76 |
| I | Heavy industry | 52 | 33 | 85 | 0.06 | 1,277.4 | 35.8 | 1,313.2 | 5.74 |
| J | Dwellings with yard meters | 3 | 403 | 406 | 0.26 | 2.0 | 81.0 | 83.0 | 0.36 |
| K | Yard meter accounts | 1 | 1,286 | 1,287 | 0.83 | 26.4 | 400.7 | 427.1 | 1.87 |
| L | County towns | 7 | —— | 7 | 0.005 | 275.9 | —— | 275.9 | 1.21 |
| Totals | *Fiscal year ending Sept. 30, 1955 | 676 | 154,699 | 155,375 | 100.00 | 4,930.5 | 17,945.7 | 22,876.3 | 100.0 |

*Graeser, H. J., "Distribution Losses and Meter Repair Practices," *JAWWA*, 50 (July, 1958) 926.

tem into districts for loss accounting purposes. Many systems are so divided for valve and hydrant inspection. At Knoxville the hydrants and valves are grouped into a letter and number grid designation. Of the 144 districts assigned about 70 are currently active. All valves and hydrants located in one grid are filed together. All cards for one grid are withdrawn at one time to be worked. The input to the districts can be measured by a meter or by a pitometer, and by night metering, excluding the industrial use, the minimum night hour demand can be obtained, from which the ratio of minimum night flow to average day demand may be ascertained. The water accounting form for districts is shown in Figure 8. At Dallas, Texas, the system is divided into districts, and further the customer use is segregated into twelve classifications, as shown by the Dallas water billing 1954-55, Table No 7.

### Uniform System of Accounts

Starting with the raw water to the plant (see Fig. 4, part one) the several steps for accounting purposes are designated as follows:

Raw water to plant (Qml) charge number (W1)
Raw water meter (M1)
Finished water meter (M2)
Finished water meter registration (Qm2)

As previously mentioned, the accuracy of the meters delivering water to the system is of prime importance and their precise calibration must be the first objective in this program.

**Table 8**
**Water Accounting Balance Sheet**
**January, 1958**
**Alpha Water Utility**

| Input Account Million Gallons | | Outgo Accounts Million Gallons | | |
|---|---|---|---|---|
| Input | | Outgo | | |
| W2 Distribution System Input | | Sales Accounts | | |
| W2.1 Well No. 1 | 100.00 | W3 Meters Sales | | |
| W2.2 Well No. 2 | 50.00 | W3.1 Domestic | 200.00 | |
| W2.3 Plant | 210.00 | W3.2 Commercial | 63.00 | |
| W2.9 Plant Use | (10.00) | W3.3 Industrial | 20.00 | |
| Total W2 Distribution System Input | 350.00 | W3.4 Public | 5.00 | |
| | | Total W3 | 288.00 | |
| | | Unmetered Sales | 2.00 | |
| | | Total Sales | | 290.00 |
| | | Loss Accounts W5 through W9 | | 60.00 |
| | 350.00 | | | 350.00 |

### Distribution Input Account

The water delivered to the distribution system is designated as (Di) charge number (W2). This account may be expanded to include the components as required to suit a particular situation. For example, the balance sheet for a theoretical utility shown at Table No. 8 indicates the three sources comprising the input from which the plant use (W2.9) is deducted to obtain the net to the distribution system. This balance sheet, it will be noted, follows the style of a financial balance as the input and outgo sides must balance. It can be planned to show the previous month or year figures for ready comparison. It may be made for the entire system or for each district, if the program is divided into districts.

### Distribution Outgo Accounts

The outgo side of the balance sheet, Table No. 8, is similar to the liability side of the financial balance sheet. Sub-account numbers are shown for the several classifications of metered sales, and the same method may be used for unmetered sales. The water accounting chart, Fig. 9, shows the outgo accounts are made up of sales accounts and loss accounts as follows:

Di = Ds + DL
Di = Distribution input, input account W2
Ds = Distribution sales, outgo accounts W3 and W4
DL = Distribution loss, outgo accounts W5 through W9

| REFERENCE NUMBER | IV 1* PLANT INPUT | W 2 DISTRIBUTION SYSTEM INPUT | | | | | W 3 METERED SALES | | | | | | W 4 UN-METERED | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | | | | | | | | | |
| | RAW WATER | FINISH WATER | IS SLIPPAGE OF PLANT METERS INCLUDED | | IS PLANT USE INCLUDED ITEM 2e HOW MUCH? | DATE | DOM. W 3.1 | COM. W 3.2 | IND. W 3.3 | PUB. W 3.4 | OTHERS W 3.5 | | FIRE W 4.1 | SEW. DISPOSAL PLANT | SEW. SYST. FLUSH & REPAIR |
| | MGM** | MGM | Percentage | MGM | MGM | | MGM | MGM | MGM | MGM | MGM | | MGM | MGM | MGM |

FIG. 10. WATER ACCOUNTING FORM.

The sum of the sales accounts and loss accounts must equal the input account. The Water Quantity Accounting Chart, Fig. 9, illustrates the breakdown of account numbers to include the various sources of loss.

### Sales or Revenue Accounts

The sales accounts will include all metered sales (W3) and unmetered sales (W4). Each of these accounts may be expanded to segregate the several component parts, and it is advisable to do so in a loss control program.

Metered sales (W3.) may be expanded as follows:

Domestic meter registration W 3.1

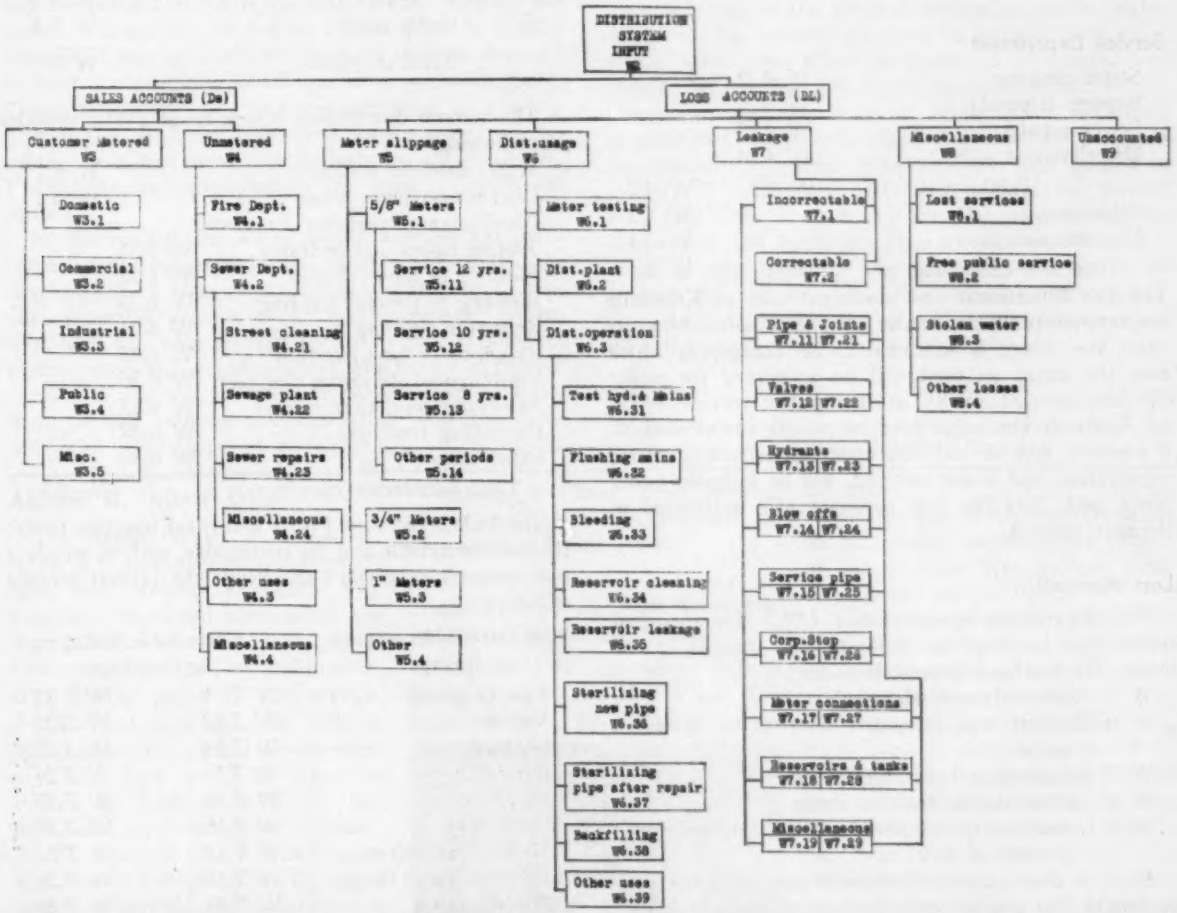



FIG. 9. WATER QUANTITY accounting flow sheet for distribution.

| SALES | | | Ds SOLD | W 5 CUSTOMER METER SLIPPAGE | W 6 USAGE (DISTRIBUTION SYSTEM) | | | | W 7 LOSS (DISTRIBUTION SYSTEM) | | | W 8 MISC. | W 9 UNAC-COUNTED FOR WATER UFW9 | | REFERENCE NUMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREET CLEANING | PUBLIC | MISC. | SUB-TOTAL | % MGM | METER TEST | DIST. PLANT | DIST. OPERATION | | INCORRECT-ABLE SEEPAGE W 7.1 | BREAK EMERGENCY W 7.2 | | | | | |
| MGM | MGM | MGM | MGM | % MGM | MGM | MGM | MGM | | MGM | MGM | | MGM | MGM | | |
| | | | | | | | | | | | | | | | |

| | | |
|---|---|---|
| Commercial meter registration | | W 3.2 |
| Industrial meter registration | | W 3.3 |
| Public sales meter registration | | W 3.4 |
| Miscellaneous meter registration | | W 3.5 |
| Total meter registration | | W 3 |

Unmetered sales (W4) may be expanded as follows:

Fire department uses estimated W4.1

**Service Department**

| | | |
|---|---|---|
| Street cleaning | W 4.21 | |
| Sewage disposal | W 4.22 | |
| Sewer repairs | W 4.23 | |
| Miscellaneous | W 4.24 | |
| Total | W 4.2 | W 4.2 |
| Other uses | | W 4.3 |
| Miscellaneous uses | | W 4.4 |
| Total estimated quantity | | W 4 |

The fire department and municipal uses at Knoxville are revenue producing under unmetered sales. In many cities this usage is extended at no charge, in which case the water so used will be accounted for under the loss account (W8) as free public service W8.2, see figure 9. The water used by private fire protection, if metered, will be included under miscellaneous meter registration, and if not metered, will be included under other uses. Any flat rate accounts will be treated in the same manner.

**Loss Accounts**

The distribution-system losses (DL) are classified under five headings to facilitate the analysis of all losses. The five basic classifications are:

W 5 Estimated meter slippage
W 6 Metered and estimated distribution system usage
W 7 Estimated and reported leakage
W 8 Estimated miscellaneous losses
W 9 Imbalance, out of pocket, or unaccounted for quantity (Ufw9)

Each of these classifications will now be considered in detail: The account estimated meter slippage (W5) may be expanded as follows:

| | | |
|---|---|---|
| 5/8" meters in service 12 years | | W 5.11 |
| 5/8" meters in service 10 years | | W 5.12 |
| 5/8" meters in service 8 years | | W 5.13 |
| 5/8" meters in service other periods | | W 5.14 |
| Total 5/8" meters | | W 5.1 |
| 3/4" meters | | W 5.2 |
| 1" meters | | W 5.3 |
| Other meters | | W 5.4 |
| Total all meters | | W 5 |

The account distribution system usage (W6) includes the following:

| | | |
|---|---|---|
| Water used for testing | | W 6.1 |
| Distribution plant usage | | W 6.2 |
| Distribution Operation Expanded | | |
| Testing mains and hydrants | W 6.31 | |
| Flushing or blow-off uses | W 6.32 | |
| Bleeding to prevent freezing | W 6.33 | |
| Reservoir cleaning | W 6.34 | |
| Reservoir or tank overflow | W 6.35 | |
| Flushing and sterilizing new pipe | W 6.36 | |
| Sterilizing pipe after repairs | W 6.37 | |
| Backfilling trenches | W 6.38 | |
| Other uses | W 6.39 | |
| Total distribution operation | | W 6.3 |

The leakage account (W7) is divided into two parts: the non-correctable and the correctable, each of which is appropriately subdivided to include the several sources of loss:

| Non-correctable seepage or leakage | | Correctable leakage or breakage |
|---|---|---|
| Pipe or joints | W 7.11 | W 7.21 |
| Valves | W 7.12 | W 7.22 |
| Hydrants | W 7.13 | W 7.23 |
| Blow-offs | W 7.14 | W 7.24 |
| Service pipe | W 7.15 | W 7.25 |
| Corp. stop | W 7.16 | W 7.26 |
| Meter Connections | W 7.17 | W 7.27 |
| Reservoirs and tanks | W 7.18 | W 7.28 |
| Miscellaneous | W 7.19 | W 7.29 |
| Totals | W 7.1 | W 7.2 |

The miscellaneous account (W8) consists of the following:

| | |
|---|---|
| Lost services | W 8.1 |
| Free public service | W 8.2 |
| Stolen water | W 8.3 |
| Other losses | W 8.4 |
| Total | W 8 |

The concluding account (W9) is the unaccounted for water (Ufw9). In the day to day application of this system the information from the field must be regularly given to the water quantity accountant by the several reports described. He then enters these on a form and finally compiles a summary as a monthly report. A proposed water accounting form is shown. Of course, to suit a specific utility some additions or deletions of the account numbers will be required. This program is intended as a means for determining the source of all loss, and defining that portion which may be feasibly corrected. The accounting system is applied to the Knoxville operation for the month of January, 1959, as shown in Table No. 9.

Table 9
**Water Accounting Balance Sheet**
**January, 1959**
**Knoxville, Tenn.**

| Input Accounts Million Gallons | | | Outgo Accounts Million Gallons Sales Accounts | | | |
|---|---|---|---|---|---|---|
| Acct. No. | | | Acct. No. | | | |
| W2 | Distribution System Input | | W3 | Metered Sales | 474.572 | |
| W2.1 | Plant | 607.870 | W4 | Unmetered Sales | | |
| W2.9 | Plant Use | 22,362 | W4.1 | Fire Department | 1.920 | |
| | Total W 2 | 585.508 | W4.21 | Street Cleaning | 2.216 | |
| | | | W4.22 | Sewage Disposal | 0.162 | |
| | | | W4.23 | Sewer Repairs | 0.685 | |
| | | | W4.3 | Market House | 0.350 | |
| | | | W4,4 | Miscellaneous | 0.011 | |
| | | | | Total Sales | | 479.916 |
| | | | | Loss Accounts | | |
| | | | W7.15 | Service Leaks | 3.000 | |
| | | | W6.1 | Meter Testing | 0.500 | |
| | | | W7.21 | Leaks & Repairs | 7.500 | |
| | | | W6.32 | Blow-offs | 2.000 | |
| | | | W6.2 | Distribution Building | 0.607 | |
| | | | | Total | | 13.067 |
| | | | W9. | Unaccounted for Water | | 92.525 |
| | | 585.508 | | | | 585.508 |

### Summary and Conclusions

In view of the great obvious need for added attention to the loss of water in the distribution system, it seems some method of standard practice should be adopted by the industry. From personal observations and the perusal of much literature on the subject, the author presents this method as a basic plan. It is fully recognized that additions or deletions may be required to meet the operating conditions of a particular plant. The program may be conducted somewhat as a safety program—to engender enthusiasm among personnel, resulting in a loss conscious attitude by all concerned. If this can be accomplished, the plan is certain to succeed.

In this country the water supply industry has made commendable progress in the building of plants, the development of techniques, and the know-how to provide a potable product to an ever increasing population. This has been accomplished in a land of plentiful natural resources, including water. We have now reached a place in our history where many observers and students of the problem are concerned with the probability of a shortage of resources. It, therefore, behooves the water supply industry to examine methods that will lead to the prudent utilization of the water resources. Fortunately, this can be accomplished while at the same time effect an economic advantage. Reducing the existing loss in the many distribution systems can defer the need for costly plant expansion in some utilities. It will provide better service to existing customers. Several instances have been related in this article where the reduction of loss has proved very profitable. It is hoped the plan as presented in this article will focus attention to this important segment of the industry and encourage further study toward the end of eliminating needless waste which is certain to benefit the water supply industry and all of the people of these United States.

### Reference

18. U.S. Federal Power Commission, Uniform System of Accounts, U.S. Government Printing Office, 1937.

## Alfred R. Abelt Dies

The sudden death of Alfred R. Abelt, 71, former vice president of sales and director of Chain Belt Company, has been announced. He died Monday morning, Sept. 11, at Columbia Hospital, in Milwaukee, after a brief period of confinement.

Abelt was born May 28, 1890 in Milwaukee and started employment at Chain Belt in 1906. When he retired in June of 1957, he had been associated with the company for 51 years, a record which made him one of the oldest employees in length of service. His experience in the field of marketing and his development of Chain Belt's district sales force was highly important to the growth of the company.

## Staggered Joints Add Strength in Gang Forming Walls

Staggering the horizontal joints in his ganged section, Bob Poole, job superintendent for Brighton Construction Co., Chicago, achieved added strength in his concrete pours on the sludge concentration project of the Chicago Metropolitan Sanitary District plant in Cicero.

Not an earth-shaking discovery Poole will be the first to admit, but it is one more bit of useful information for contractors.

For the sludge tanks, Poole has used ganged sections up to 35 by 16 ft and by using three different size Symons Clamp forms so that the horizontal joints never met, he has been able to pour these walls without using strongbacks.

In all, about 3,000 cu yds of concrete were poured for the job.

VANADIUM CORPORATION'S ferroalloy manufacturing plant at Vancoram, Ohio.

# Disposal of Sanitary Sewage from Industrial Plants

by J. R. LEE and H. R. GRADY
Director, Engineering Design
and Director, Chemical Research
Vanadium Corp. of America

EDITOR'S NOTE: Disposal of sanitary wastes from an industrial plant, in the absence of municipal sewers, is often a perplexing problem. The article tells how one such company took care of its sanitary effluent.

■ THE DISPOSAL OF SANITARY SEWAGE from an industrial plant not served by a municipal system is a problem that must be given serious consideration if the plant is to be a good industrial neighbor. When Vanadium Corporation of America built its ferroalloy manufacturing plant at Vancoram, Ohio, near Steubenville, every effort was made to make the plant attractive and to meet the requirements of a good industrial neighbor. The installation of a Rated Aeration* process sewage disposal plant has met this responsibility while requiring no chemical additions and a minimum of attention.

The sewage disposal system at Vancoram is designed for a maximum flow of 15,000 gpd with a minimum detention period of 24 hours. The system consists of a comminutor aeration tank complete with blowers, air diffusion and froth control equipment, settling tank and V-notch measuring weir.

Raw sewage is brought to the disposal plant through an 8 in. sanitary sewer. It first passes through a comminutor which is designed to cut and screen the coarse material in the raw sewage continuously and automatically. The comminutor is driven by a ¼ hp vertical gear head weatherproof motor. From the comminutor, sewage passes into an aeration tank which is 18 ft long, 14 ft wide, 9 ft 3 in. deep. Normal depth in the aeration tank is maintained at 8 ft, giving it a capacity of 15,000 gallons, equal to the rated daily flow. The aeration tank is equipped with an air diffusion unit consisting of ten diffuser tubes spaced and mounted along a diffuser tube header, all mounted on a swing joint assembly for suspending and raising the complete unit out of the tank. A manually operated winch type hoist is used for this operation.

Air is supplied to the air diffusion equipment by two Sutorbilt Model 4M positive displacement blowers,* each rated to deliver 93

*Product of: Chicago Pump Co. Chicago, Illinois.

*Product of: Sutorbilt Corp., Compton, California.

cfm at 4.5 psi. Blowers are operated one at a time, powered by 5 hp motors.

The aeration tank is equipped with a froth control spray system consisting of three nozzles capable of producing a hard flat spray and operated by a pump rated at 10 gpm against 50 tdh and powered by a ½ hp, 3,500 rpm electric motor. The froth control system has not been used up to this time, and it is believed that it will not be needed in a normal industrial sewage disposal system.

**Table 1**

**Typical Plant Report**

| | |
|---|---|
| Flow (mgd) | 0.175 |
| Suspended Solids, ppm | |
| Aeration Tank | 2205 |
| Final | 121 |
| Dissolved Oxygen, ppm | |
| Raw | 2.7 |
| Final | 6.2 |
| Stream Above | 12.9 |
| Stream Below | 12.9 |
| BOD, ppm, | |
| Raw | 353 |
| Final | 32 |
| Stream Above | 3.4 |
| Stream Below | 3.4 |

From the aeration tank, sewage passes into a settling tank, 10 ft long by 7 ft-6 in. wide and 12 ft-3 in. deep and equipped with a series of baffles and an outlet weir. The settling tank has a 3 in. air lift eductor which returns sludge from the settling tank to the comminutor inlet.

**AERATION TANK with hand winch for raising aeration piping and settling tank. Sludge pond is in background.**

From the settling tank, effluent sewage enters a 12 in. pipe and is discharged directly into Cross Creek which flows through the Vancoram property.

The Vancoram plant is required to reduce BOD of the sewage influent by a minimum of 85 percent. The Department of Health for the State of Ohio requires a bimonthly report of the quality and quantity of the effluent discharged into Cross Creek. A typical report to the Department of Health is shown in Table 1.

Other than the bimonthly tests and routine maintenance inspections, the sewage disposal system has not required any attention during a two year operating period. Operating costs on this system have been negligible.

## Water Supply And Pollution Control Grants

The Research and Training Grants Branch of the Division of Water Supply and Pollution Control reports that 142 Public Health Service research grants, totaling $2,116,804, were awarded in the field during the fiscal year 1961.

These research grants were made to institutions in 37 States and the District of Columbia.

Of the year's total, $761,793 was allocated to support 47 new research grants. The remainder was for the continued support of previously approved grants.

A complete list of research grants awarded is available from the Chief, Research and Training Grants Branch, Division of Water Supply and Pollution Control, Public Health Service, Washington 25, D. C.

### A CORRECTION

It was brought to our attention that Part 2 of Dale Smelser's article *Water Utility Distribution Loss* which appeared in the September issue of W&SW contained an error. On page 337, the formula reading:

$$L = \frac{N D P}{1850}$$

should have read:

$$L = \frac{N D \sqrt{P}}{1850}.$$

## Birmingham, England, Sewage Report Received

The Birmingham Tame and Rea District Drainage Board Report for 1957-1959 was received containing many interesting facts accumulated over the period.

The Board, for example, levied a Precept on its constituent authorities for one year totaling $16,254,000 and $8,000 per year was spent on fly control for one dump.

In 1959, the estimated population of the area was 1,365,000 and the estimated average daily flow in Imperial Gallons was 81,584,000.

The board also reported several interesting research projects being carried on by the authority.

# Wisconsin Section AWWA Holds 40TH ANNUAL CONFERENCE

■ NEARLY 400 MEMBERS of the Wisconsin Section American Water Works Association met September 27-29, 1961, at the Hotel Schroeder in Milwaukee, Wisconsin. Special events during the conference were: Section Secretary, Harry Breimeister, nominated to receive the annual Fuller Award and life memberships extended to A. P. Kuranz, retired manager of the Waukesha Water Utility and to H. G. Reichardt, Water Commission Superintendent, Watertown, Wisconsin. Section's entry in the National Advancement competition will be that of Beaver Dam.

### Water Resources Session

Factors affecting future well yields were discussed by **Charles L. R. Holt, Jr.** of the U. S. G. S., Madison, Wisconsin. Using diagrams, ground water resources were illustrated, together with the future possible yields of Wisconsin aquifers. Well operating procedures were explained involving the use of observation well and the knowledge of pump operation and aquifer history. Future well yields may be calculated from a knowledge of existing conditions including drawdown and pumpage rates.

Milwaukee's $50,000,000 Water Works Construction Program was explained by **E. A. Schmidt,** City Engineer, and **William Hammann,** Engineer in Charge, Water Engineering Division. Slides were used to illustrate the handling, storage, and installation of 108 in. concrete raw water intake piping and intake station. Also included in the construction program is a pumping station on Texas Avenue and the Howard Avenue Purification Plant designed to handle 100 mgd on its completion in Early 1962.

### Water Quality Session

Micro-Straining at Kenosha—Economy and Water Quality Observed was discussed by **O. Fred Nelson,** Manager, Kenosha Water Department, and **Kenneth Mackenthun,** Biologist, Committee on Water Pollution, State Board of Health, Madison, Wisconsin. The four microstrainers installed in July, 1961, at Kenosha, are designed to handle 20 mgd of raw water containing filter plugging algae. The units were installed preceding any other treatment at the plant, and operation has shown that they consume 1½ to 2 percent wash water at the 20 mgd rate. Microstrainer effluent is recirculated for use as wash water. Rapid sand filter runs have increased from 35 to 70 hours on the average, no taste and odor complaints were received during the summer and sprinkling restrictions were not necessary during the past season. $2.50 per million gallons were saved during the months of July and August on chemical treatment costs.

Sample analysis from Kenosha raw water and microstrainer effluent determined that, during 29 days of operation, the units accomplished 91.9 percent algae removal.

Economics of Softening of Municipal Water Supplies were discussed by **L. R. Howson,** Alvord, Burdick and Howson, Chicago. Economics surrounding the use of reasonably softened water have not been thoroughly studied, and it is difficult to place an economic figure on the aesthetic values obtained through the use of softened water. Approximately one-half of the Wisconsin urban population uses water containing in excess of 200 ppm. It was shown that costs for softening may be expected to increase 15 percent over a regular filter plant where operation 100 percent of the time is not required to produce 5-7 grains per gallon hardness containing water. Charts illustrated the effect of lime-soda treatment on capital costs in plants having capacities of 5, 10, 15 and 20 mgd.

A survey of some Wisconsin municipalities indicate that in communities having 200 ppm water hardness, 30 percent of the users own or rent individual water softeners. In communities where hardness is 275 ppm, 60 percent of the users own or rent their own units, and in communities where 350 ppm is the total hardness, 90 percent of the customers own or rent their own hardness removal units. The cost of domestic softening is from $1.00 to $1.75 per thousand gallons in removing or lowering the hardness from 400 to 100 ppm. Some savings in soap and synthetic detergent consumptions can be realized, using softened water, as learned from an Illinois study by Larson and DeBoer. The first water softening plant was constructed in Oberlin, Ohio, in 1905. In 1960 there were 1300 water softening plants serving more than 15 million people.

Mr. Howson concluded that people like and want soft water and the cost is not a deterrent to its use. He suggested that it was in the consumer's interest to provide hardness removal at plants now processing excessively hard water.

### Committee Reports

**William U. Gallaher,** Water Superintendent, Appleton, reported on progress toward obtaining voluntary certification of water works operators. An outline of progress to date was presented and members were asked to indicate whether proposed certification should follow plant classification or demonstration of operator proficiency. Progress of the Advancement Committee was presented by **Leroy J. Beckman,** Wallace & Tiernan, Inc., and Safety by **Ervin C. Wege** at Milwaukee. Membership indicated that 75 new members have been added since the meeting last year, with a total at meeting time of 349. Water Resources committee activities were discussed by **A. J.**

VIEW OF Chemical Building and Drive House at Milwaukee's new Howard Ave. filtration plant.

**Jark,** Superintendent, Water and Light, Jefferson.

### Distribution and Pumping Session

The Importance of Thrust Reaction Blocking on Mains and Fittings was described by **R. G. Jones,** Associate, Donohue and Associates, Inc., Sheboygan. He reviewed the theory of static thrusts in pipelines and used tables to illustrate reaction loads and thrust block areas. The general practice currently lacks standardization and pipeline installation depends on the crew foreman or other supervision from utility representatives. A review of existing conditions should include an analysis of criteria to be used when compression joints are being used, in the presence of traffic on municipal streets, large mains, and the possibility of civil defense requirements. These might reveal an increased requirement for more blocking and deeper laying of feeder mains.

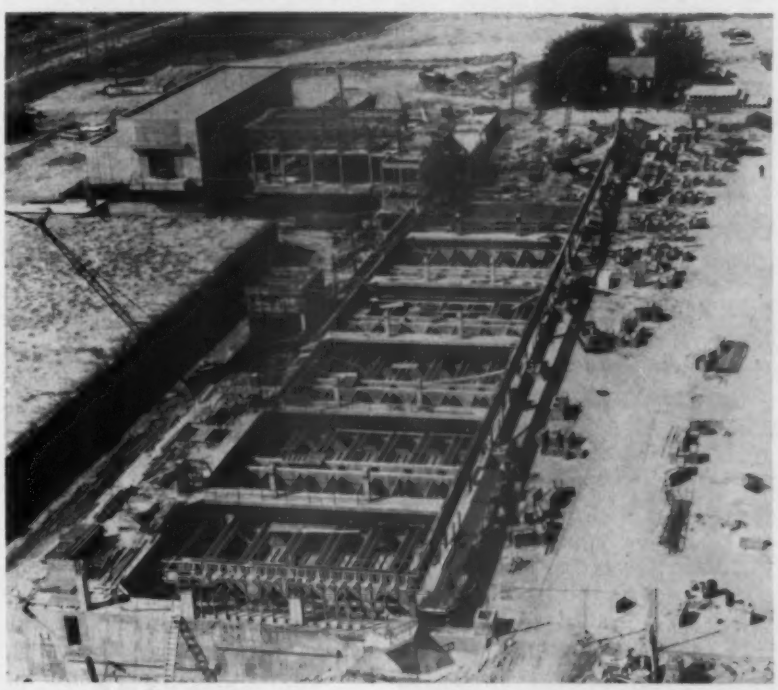
Needs were described in a review of present methods: increased use of poured concrete blocks on 8" and higher main sizes, avoid too wide trenching, and use the maximum depth possible. Also, use cushioned check valves and air relief devices to offset and control water hammer effects.

Evaluation of Water Plants for Fire Needs was provided by **Allen S. Dimoff,** Fire Insurance Rating Bureau, Milwaukee. He pointed out that the Fire Insurance Rating Bureau is supported by the fire insurance companies as a nonprofit organization. The Bureau estimates fire insurance rates for individual properties based on the degree of public fire protection using a 1 through 10 point system. The water supply and distribution system is one of the elements considered in establishing a rating. The adequacy of a system to provide fire flow over and above the regular demand, system storage, and maximum use of tank capacity; the reliability of pumping units and piping and valving to avoid downtime due to breakage or other reasons are also included. The availability and use of standby engines for pump power, plus the ability of personnel, are also considered in the study.

### Management Session

The Impact of Water Main Extension Policy on Rates was described by **Orville P. Deuel,** Public Service Commission of Wisconsin. The utility must serve water to all city property and such property outside as arrangements may require. Three basic concepts are applicable to water main extension policies: *public utility,* where up to eight times the gross revenues from an area may be invested. *Community improvement,* acquired community funds, as they may be available, are used, by use of funds

CONTINUED ON PAGE 104A



VIEW SHOWS Howard Ave. plant's Sand Filters and Pumping Station (upper left.)

# KEEP 'EM ROLLING

by C. G. Cunningham

■ HAVE YOU made your plans to winterize your water and sewer department trucks yet? It's time. Be sure every water cooled rig on your lot gets the works.

Most departments have a set pattern of fleet winterization. Yours may be good, it may be hit or miss, or it may be only a plan that is on the books but not used. Now is the time to take out those winterization plans, give them a working over, and see if they are doing the job that must be done. Try to plug up any holes you can find, and improve the system. Here are some suggestions that other shops have found workable:

*Electrical system*: Remember that a battery works harder in winter due to increased demands on it from the cold weather. So check the charge on each battery cell, check the generator, the cranking motor, voltage regulator, lights and exposed wiring. Adjust the voltage regulator to be sure it is supplying just as much juice as your system drains under normal operations.

*Engine*: Drain the crankcase and refill with the lighter winter oil that is recommended for your area.

*Fuel System*: Drain and flush the fuel tank of your trucks and all fuel lines. Clean or replace a fuel filter if you use one, and give your carburetor a good check or reconditioning.

*Cab*: Replace any broken glass, check windshield wipers, heaters, washers, defrosters and give the cab a good interior cleaning.

*Body and Chassis*: Remove all rust, and touch up the spots. Repair any sheet metal that needs it and repaint if necessary.

*Accessories*: Check operation of all engine and cab accessories, and repair or replace any that need attention.

*Hydraulic system*: Drain and flush the whole system. Then refill with the recommended hydraulic fluid for that rig.

*Air System*: Blow all water from your air tank lines on your rigs with air brakes. Then install an alcohol vaporizer to prevent air line freeze up.

*Cooling System*:

- Drain radiator, engine block, all heaters. Remember there may be more than one drain point on the engine these days.
- Flush the system, and use a cleaner if needed. Be sure to remove the thermostat before flushing, so water will circulate through the system.
- Check operation of the thermostat in a pan of hot water to be sure it opens and closes at the desired temperatures.
- Check for malfunctioning radiator cap, hoses, gaskets, drain cocks, plugs, fanbelt, fan and water pump.
- Determine antifreeze protection required. Add proper quantity of antifreeze, then fill with water until tank is almost full. Start motor and check all hoses and leak points again.
- Blow dirt out of radiator fins.
- Allow filled radiator to warm completely, then check with hydrometer for cooling protection.

What about the year-round coolants that are now on the market? Can you use them in your water department rigs? Most experts say that they are good, and can be used for the two years recommended. Naturally you want to check these fluids regularly for antifreeze protection and for rust inhibitor level. Many new trucks will soon come out with the year-round coolant fluids as original equipment. If Detroit thinks the fluids are this good, they must have merit.

*Wish your blinker turn signals were brighter?* They soon will be. An auto industry group is working on a cooperative venture to give them four times the intensity during daytime, but cut down the power to present intensity to prevent glare at night. When headlights are turned on, the blinker's brightness automatically dims. This dual intensity also shows up on the dash indicator.

*Keep a pressure cap on your cooling system.* Many trucks will run fine without a pressure cap, but when the going gets tough—long hills, heavy loads, hot weather—then is the time when that pressure cap pays off. Under pressure, water has a higher boiling point. That means your radiator can take care of more heat without a boil problem. So if your rig is designed to use a pressure cap, keep one on it.

*Do you have a torque wrench in your shop?* They should be standard equipment these days. No more guessing how tight to make those bolts. Torque it to the specifications in your manual. If you don't get a bolt tight enough, it vibrates loose. If you tighten it down too hard, you might snap the stud or damage the threads. Remember metal is elastic to a certain degree. Overtightening can lead to over-stretching the metal and failure.

*Dipsticks don't lie!* The dipstick is a very simple little gauge—in fact so simple that there is no way for it to lie. When it says the crankcase is full, it is full. Overfilling an engine can mean foam buildup which means poor lubrication. On an automatic transmission overfilling causes sprung seals. Of course if you change the oil filter when you change oil, you must add a quart of oil later to replace oil that the filter holds.

## Open Country
## City Streets

### This 20-inch Concrete Distribution Line Finished 2 Months Ahead of Schedule

Although the primary advantages of prestressed concrete steel-cylinder pipe are its long life, high strength and continued high carrying capacity, the speed with which it can be installed under all conditions was demonstrated on this 20-inch distribution line at Hattiesburg, Mississippi.

The pipe was laid in open country and in town, in mud and in dry sand. Most of the job however was along city streets. Traffic was kept running smoothly and there was no interruption in water service. It was started in March and completed in October, two months ahead of schedule.

The 4.7-mile line is part of a loop around town to raise the general pressure level and provide a greater supply for fire protection.

Consulting Engineers for the project were Allen & Hoshall, Memphis. Contractor was J. B. McCrary Engineering Corp. of Atlanta, Georgia. The pipe was furnished by Price Brothers Company, Hattiesburg and Dayton, Ohio.

Price Brothers
CONCRETE PRESSURE PIPE

where performance counts...

Four Weinman Type L Pumps in use at the Nelson Road Booster Station, City Waterworks, Columbus, Ohio.

count on WEINMAN PUMPS

You'll find Weinman Pumps first preference in public installations . . . where equipment must stand the test of time and yet have a low initial cost that fits the public purse. Experience has shown cost-conscious officials that they can depend on precision-built, job-proven Weinman Pumps to provide the 'round-the-clock service they need and demand . . . and with just routine maintenance, too.

A favorite pump among engineers is the large capacity . . . up to 4000 g.p.m. . . . Weinman Type L Split Case, Single Stage, Double Suction Pump for low, medium or high (up to 400 feet) head pumping service. Its unusual versatility adapts it to a great number of pumping applications making it of even greater value for city, state and federal uses.

You just can't beat a Weinman Pump for money-saving, dependable public service. It will pay you to consult your Weinman Pump Specialist whenever you have a pumping problem.

For the advice of experience . . . look him up in the Yellow Pages ...or write direct for Bulletin 1200.

THE WEINMAN PUMP MFG. CO.
2561 SPRUCE STREET COLUMBUS 15, OHIO
CENTRIFUGAL SPECIALISTS


# Meetings

CONTINUED FROM PAGE 38A

Feb. 5-9—Cincinnati, Ohio (*Robert A. Taft Sanitary Engineering Center*) Short Course: "Radioactive Pollutants in Water." Sponsored by Public Health Service. Write: Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, or to PHS Regional Office.

Feb. 7-9—Indianapolis, Indiana (*Sheraton-Lincoln Hotel*). INDIANA SECTION AWWA. Secy., Chester H. Canham, State Board of Health, 1330 W. Michigan St., Indianapolis 7.

Feb. 12-16—Cincinnati, Ohio (*Robert A. Taft Sanitary Engineering Center*) Short Course: "Radionuclides in Water." Sponsored by Public Health Service. Write: Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, or to PHS Regional Office.

Feb. 13-14—Urbana, Ill. (*University of Illinois*) FOURTH SANITARY ENGINEERING CONFERENCE. Title: Water Distribution Systems. Sponsored by Div. of Sanitary Engineering, Ill. Dept. of Public Health and Dept. of Civil Engineering, University of Ill. Write: Prof. Ben B. Ewing, Dept. of Sanitary Engineering, Univ. of Ill., Urbana, Ill.

Feb. 13-14—Chicago, Ill. (*LaSalle Hotel*) THE AQUATIC WEED CONTROL SOCIETY. Write: Paul W. Eller, c/o Chipman Chemical Co., Inc., 608 S. Dearborn St., Chicago 5, Ill.

Feb. 26-Mar. 9—Cincinnati, Ohio (*Robert A. Taft Sanitary Engineering Center*) Training Course: "Water Quality Management." Sponsored by Public Health Servcie. Write: Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio, or to PHS Regional Office.

Mar. 14-16—Baton Rouge, Louisiana (*Louisiana State University*) LOUISIANA CONFERENCE ON WATER SUPPLY AND SEWERAGE. Secy., George H. West, P. O. Box 895, Water Dept., Lake Charles, La.

Mar. 15—Boston, Mass. (*Statler Hotel*) NEW ENGLAND SECTION *AWWA*. Secy., Ralph M. Soule, San Engr., State Dept. of Public Health, 511 State House, Boston, Mass.

March 28-30—Chicago, Ill. (*Sheraton Towers Hotel*) ILLINOIS SECTION AWWA. Secy., D. W. Johnson, 3440 Prudential Plaza, Chicago 1, Ill.

Apr. 5-7—Bozeman, Montana. MONTANA SECTION AWWA. Secy., A. W. Clarkson, Div. of Environmental Sanitation, State Board of Health, Helena.

Apr. 11-12—Albany, N. Y. (*Manger DeWitt Clinton Hotel*) NEW YORK SECTION AWWA. Secy., Kimball Blanchard, Neptune Meter Co., 2222 Jackson Ave., Long Island City.

Apr. 12-13—Morgantown, West Virginia (*Hotel Morgan*) WEST VIRGINIA SECTION AWWA. Secy., Thomas J. Blair, Kelley, Gidley, Staub, Inc., 5418 Mac Corkle Ave., S. W., Charleston.

Apr. 15-18—Jekyll Island, Ga. (*Wanderer Resort Motel*) SOUTHEASTERN SECTION AWWA. Secy., N. M. deJarnette, Robert & Co. Assocs., 96 Poplar St., N. W., Atlanta, Ga.

# TAKING THE IRON OUT OF WATER

## Here's how 4 water plants do it with a minimum of manpower

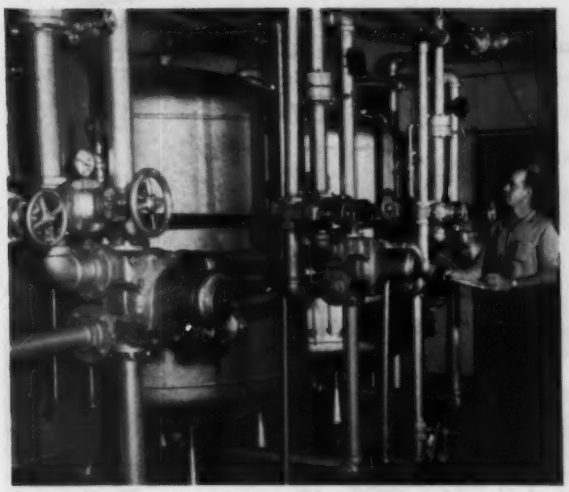
Dissolved iron (Fe) as high as 10 ppm or more can be decreased to acceptable minimums by Permutit Pressure Filters. Of course, it is necessary to first oxidize the dissolved iron by either aeration or chemical treatment to precipitate it from solution.

With Permutit Pressure Filters, iron reduction as well as color and turbidity removal is accomplished at satisfyingly low cost, both initial and operating. All of the filters shown here are equipped with Permutit's labor-saving Multiport valve which does the work of five separate valves and has but three settings — "backwash", "rinse" and "service". Fully automatic, as well as manual, Multiport Valve controls are available for Permutit Pressure Filters to provide the ultimate in time saving and efficiency.

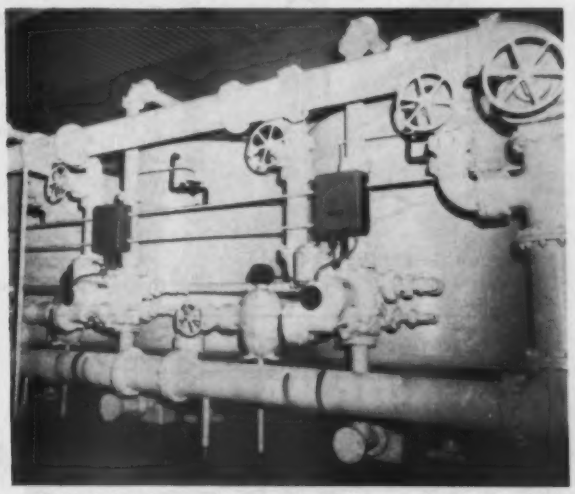
If you would like to know more about iron removal, or filtration in general, with Permutit Pressure Filters, we will be glad to send you a copy of our Bulletin 2225-C on the subject. Write to: Permutit Division, Pfaudler Permutit Inc., Dept. WS-111, 50 W. 44th St., New York 36, N. Y. In Canada, contact the Permutit Company of Canada, Toronto.

PFAUDLER PERMUTIT INC.

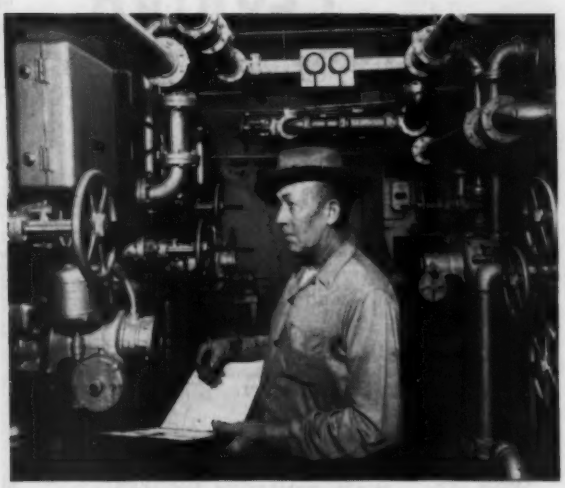
Specialists in FLUIDICS...the science of fluid processes



**Sebree, Kentucky:** V. A. Craig, Filter Plant Operator, checks these Permutit Pressure Filters which reduce iron content of city water from 2.5 ppm to 0.1 ppm, and color from 10 to 3. Mayor James Horner reports, "We are pleased with operation; water is much more satisfactory."



**Rushville, Indiana:** Here, water from various wells passes through automatically controlled Permutit Pressure Filters and softeners. Iron varies from 4.0 to 10.0 ppm; manganese from 0.00 to 0.3. Both are removed effectively.



**Carmel, Indiana:** Permutit Pressure Filter and automatic softener equipment here being inspected by Curtis J. Collins, city water superintendent, reduces iron from 1.3 ppm to 0.15 ppm, color from a rating of 35 to between 5 and 10.

**Birmingham, Michigan:** This high school's water treatment includes (left) Permutit softeners and (right) Permutit Pressure Filters. Three 54" iron removal filters are seen here, each with manually controlled Multiport Valve.

# Equipment News

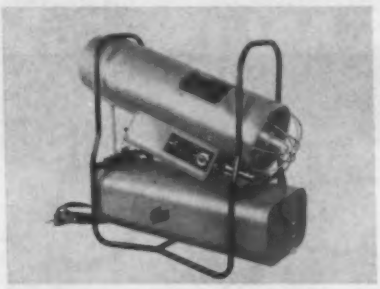
CONTINUED FROM PAGE 18A

temperatures up to 200 degrees Fahrenheit, about 60 degrees higher than conventional rigid vinyl, yet retains the advantages of strength, lightweight and corrosion resistance found in regular rigid Koroseal pipe.—B. F. Goodrich Industrial Products Co.

Circle No. 1106 on Reader Service Card

## Space Heater

A new space heater with exclusive features that make it one of the most economical on the market has been announced by this manufacturer.



The new heater is a portable oil-fired unit for temporary heating and drying in frigid working areas on construction sites, and for all industrial emergency applications. It features an exclusive new low pressure rotary-type burner that provides an amazing .90 gallon fuel consumption per hour.

Although small in size and light in weight, the unit offers the exclusive feature of controlling temperatures by output of 70,000 B. T. U. to 125,000 B. T. U. per hour, or any graduation in between by simply turning the dial from low to high.—Thor Power Tool Co.

Circle No. 1107 on Reader Service Card

## Rust and Scale Control and Water Pump Lubricant

This manufacturer has developed a product known as PROTEK-TOL, a complete liquid inhibitor for cooling or heating waters, to provide maximum protection from corrosion and scale for a minimum treatment cost.

Compounded to function effectively in the hardest of waters hot or cold, PROTEK-TOL is a mixture of phosphate sequestering agents and chromium inhibiting compounds combined with selected surface active materials. The high effectiveness of

PROTEK-TOL results in part from the action of the surfactants.—The Grintol Co.

Circle No. 1108 on Reader Service Card

## Spray Nozzles

This manufacturer offers a wide selection of spray nozzles, specifically applicable to problems of water supply and purification, as well as sew-

CONTINUED ON PAGE 91A

Synchro-Start
FULL AUTOMATIC
ENGINE
CONTROLS
FOR GASOLINE DIESEL & GAS ENGINES

Synchro-Start's new protective engine controls have been designed, for the starting and stopping of engines from remote pilot devices, such as pressure switches, float switches, power failure relays, etc., and are completely automatic in operation.

These dependable controls are encased in a steel, dust proof cabinet, and now feature enclosed PLUG-IN RELAYS as well as OVERLOAD BREAKERS. The plug-in relays simplify what little field maintenance that may have been required in older models, while the overload breakers eliminate the necessity of replacing fuses.

In designing this unit we have used the same high quality materials and workmanship that our customers have come to expect throughout Synchro-Start's 27 years of manufacturing engine controls.

SYNCHRO-START PRODUCTS, INC.
Since 1932
8151 NORTH RIDGEWAY AVENUE • SKOKIE, ILLINOIS

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FLORIDA
DOCTORS
Motel

Luxurious rooms with patios and balconies, free TV, radio, Hi-Fi in all rooms. Phones. Heated pool, boating, water ski lessons, fishing, golf, private beach. Restaurant and cocktail lounge on the premises. Everything for a perfect vacation. Credit cards honored.

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Write for literature and new TRAVEL GUIDE listing fine motels from coast to coast, inspected and approved by Congress of Motor Hotels.

# Darling B-50-B Hydrants are built for exceptional service

YOU CAN DEPEND ON

# DARLING

Packless "O" ring seals (1) cut friction while assuring complete, permanent lubrication of operating mechanism. Ball bearings (2) reduce operating torque up to 50%. Direct-acting rod (3) operates the main valve and drain valve without auxiliary components.

An extra large barrel (4) delivers water at the nozzles without appreciable pressure loss. Multi-port draining (5) with positive flushing makes stoppage or freeze-ups virtually impossible . . . *you can depend on Darling.*

Darling B-50-B Hydrants are available in types and sizes for practically every installation. Write for Bulletin 5710.

**DARLING VALVE & MANUFACTURING COMPANY**
Williamsport 11, Pa.

*The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ontario, Canada*
*Vannes Darling-France, 23 rue du Commandant Mouchotte, St. Mandé, France*

**GATE • BUTTERFLY • CHECK • SPECIAL VALVES • FIRE HYDRANTS**

# News of Suppliers

## Nichols Engineering & Research Corp. Appoints New Executive Vice President

The Board of Directors of Nichols Engineering & Research Corp., New York, engineers and suppliers of processing equipment to industry and to the sanitary engineering field, have elected Douglas R. Nichols, Jr., Executive Vice President of the firm. Mr. Nichols is a director of the organization and served formerly as Vice President and Treasurer.

## Richard A. Corbiel, President of CHEM/TECH Confident of Success

Dick Corbiel, well known to the water treatment field, received "the greatest reception I have ever had at a trade show" with the introduction of his new company's (CHEM/TECH International, Inc.) initial product—the Series/100 positive displacement hypochlorinator and chemical feed pump, at the recent Water Conditioning Show in Houston, Texas.

Capitalizing on this reception, Dick has authorized his advertising and sales promotion agency, Advertising Consultants of Boston, to implement a full-scale promotion utilizing all trade media. CHEM/TECH ads and product releases will be presenting the full CHEM/TECH line in succeeding months.

## Robert C. Beckwith Joins Henry Pratt Co.

Mr. Donald W. Coulson, Manager Manufacturing, Henry Pratt Company of Chicago, announces the appointment of Mr. Robert C. Beckwith as Manager Manufacturing Engineering. Previously, Mr. Beckwith was with the L. B. Harris Management Consultants as an Associate.

The Henry Pratt Company manufactures Rubber Seat Butterfly Valves, Ball Valves, Expansion Joints, Automatic Strainers, Nuclear Equipment and special metal fabrications. The Company is also engaged in field erection services.

## P. L. McManus Named Gen. Mgr. of Worthington's Pump Div.

Patrick L. McManus has been appointed General Manager of Worthington Corporation's Standard Pump Division at East Orange, New Jersey. He was formerly Director of Marketing Services at the Company's worldwide headquarters in Harrison.

Worthington Corporation is one of the world's leading manufacturers of a highly diversified line of capital goods equipment and machinery. The Standard Pump Division manufactures centrifugal pumps for all industrial and marine uses and rotary pumps for hydraulic systems and viscous fluids.

Mr. McManus was graduated from the University of Kansas with a bachelor's degree in mining engineering and subsequently earned a master's degree in metallurgical engineering at the University of Idaho. He joined Worthington in 1936.

## American Meter Appoints Northrop Director of Manufacturing

The appointment of Stuart J. Northrop as Director of Manufacturing of American Meter Company, manufacturer of precision measurement and control equipment for the gas industry, has been announced by William G. Hamilton, Jr., President. Northrop was previously associated with SKF Industries, Inc., Philadelphia, and Westinghouse Electric Corp., Pittsburgh.

## Sheehan Joins Fuller As Advertising Manager

Fuller Company has announced the appointment of John M. Sheehan, Jr., as advertising manager of the company.

Mr. Sheehan is rejoining the Fuller organization, where he served as assistant advertising manager from 1958 to 1960. Prior to rejoining Fuller he was a district manager for Putnam Publishing Co.

# Equipment News

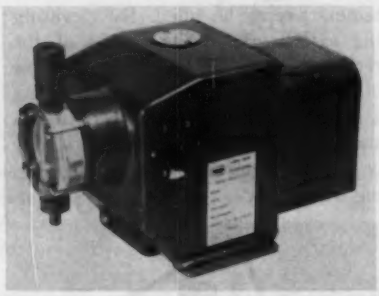
CONTINUED FROM PAGE 88A

age and industrial waste treatment. Specially-designed "no-clog" nozzles to keep down foam in activated sludge sewerage plants. Aeration nozzles for removal of excess $CO_2$ engineered to give the precise spray for optimum performance.—Spray Engineering Co.

Circle No. 1109 on Reader Service Card

## Hypochlorinators and Chemical Feed Pumps

Series/100, a new line of positive displacement diaphragm type hypochlorinators and chemical feed pumps, have been developed by



CHEM/TECH International. These units combine the most advanced engineering features for trouble-free performance, including: permanently lubricated air-cooled ball bearing motor; unbreakable PVC fittings; long-wearing worm gear train; non-corroding plastic case; sealed and self-maintaining oil immersed gear train; etc.

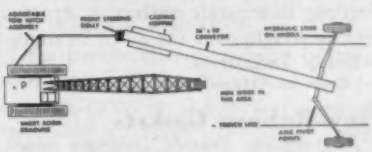
Especially designed for water treatment, these units are ideally suited for: hypochlorination; process additives; fluoridation; chemical treatment; sulphur removal; iron removal; pH control; corrosion control; and acid feeding.—CHEM/TECH International.

Circle No. 1110 on Reader Service Card

## New Trench Backfill Conveyor

A new Trench Backfill Conveyor that allows simultaneous excavating, backfilling and pipe-laying speeds up sewer construction work considerably. Called the Model 161, this machine is engineered and built by Kolman Manufacturing Company.

To assure continuous operation, the Model 161 is shackled to the excavation machine by way of a rigid tow bar. Spoils are cast from the dragline, shovel or trencher directly into a casting hopper over the



conveyor. Materials are then moved along the conveyor belt 50 feet; this distance allows pipe laying crew ample time to complete work while spoils are being discharged over completed pipe sections.—Kolman Manufacturing Co.

Circle No. 1111 on Reader Service Card

## Reduction Gear Boxes for Fractional HP Variable Speed Drives

A series of single and double reduction gear boxes for fractional horsepower variable speed drives is announced by this manufacturer. These drives are available in ¼ through ¾ hp, with speed variations from 2:1 through 10:1. A ¼ hp drive with 2:1 speed variation gives output speeds from 10 rpm minimum

to 4660 rpm maximum. Other sizes and speed variations provide similar output ranges.—Sterling Electric Motors, Inc., a Subsidiary of Hathaway Instruments, Inc.

Circle No. 1112 on Reader Service Card

## Compact Everguard Monitors Liquid Levels

An entirely restyled electric "watchdog" that sounds a clearly audible alarm, automatically shuts off pumping equipment, opens or shuts solenoid valves, or cuts in auxiliary supplies whenever a specific liquid low or high level is reached is being marketed.

Called the Everguard, this electrically controlled liquid alarm features a buzzer that can be heard at least 50 feet away. With a simple alternate wiring installation, the Everguard will start or stop a pump, and energize solenoid valves when the critical liquid level is reached. Besides being an important accessory to warn automatic chlorination-equipment operators that their chlorine solution-level is low, the new instrument has unlimited application whenever low or high liquid levels need to be controlled.—Everpure, Inc.

Circle No. 1113 on Reader Service Card

## Utility Bodies

New Reading utility bodies job-planned for exterminating service are reported to be saving operators in

their field an average of one hour per job. The time-saving results from provisions for customized file-box arrangement of tools and equipment in outside compartments where they are quickly accessible, eliminating waste motion and time spent hunting for needed items.

Other important advantages of these bodies are the safety factor represented by locked compartments for chemicals and the fact that tools and equipment are fully protected from bad weather.—Reading Body Works, Inc.

Circle No. 1114 on Reader Service Card

## Continuous, Volumetric Feeding of Fluoride Compounds

This manufacturer has recently re-released a new bulletin describing methods and equipment for accurate, continuous, volumetric feeding of fluoride compounds to a water treatment system.

CONTINUED ON PAGE 92A

# Equipment News

CONTINUED FROM PAGE 91A

The model 23-02 Table Feeder, with its accessory equipment, provides an efficient, accurate method of feeding fluoride compounds, checking rate of feed by the loss-in-weight principle, indicating and recording by scale head recorder and dissolving of the compound in a steel, plastic-lined dissolver prior to distribution.

The Fluoridizer has a feed rate range of 20 to 1 by gate adjustment alone. Two alternate change gears are furnished for proper range selection to meet feeding requirements. Ranges may be 4 oz to 5 lbs per hour up to 1 lb to 20 lbs per hour. Feeding is accurate within ± 3 percent by weight over the 20 to 1 range. —B-I-F Industries.

**Circle No. 1115 on Reader Service Card**

## Vinyl-Rubber Gaskets

A complete line of concrete pipe gaskets in cross-section shapes of vinyl have a compression core of live, resilient rubber to effect a tight, permanently flexible seal according to the manufacturer.

The exposed gasket of vinyl is more resistant to chemical, bacterial and fungus attack, while the protected core of natural rubber retains better flexibility and flow characteristics.

V & R (T.M.) gaskets fit grooves or circumferential offsets of concrete pipe spigot ends and are easily installed.—National Coupling Co., Inc.

**Circle No. 1116 on Reader Service Card**

**TRIANGLE BRAND COPPER SULFATE**

Small, economical dosages of Triangle Brand Copper Sulfate will make your water supply palatable. It destroys algae and aquatic weeds that cause bad water odors and give water an unsavory taste. ■ Another important use of Triangle Brand Copper Sulfate is for the control of root growths, fungi and slime in sanitary sewers and storm drains without damaging trees and shrubs. ■ Write today for complete information on the use of Triangle Brand Copper Sulfate in water supply systems, sewers and drains.

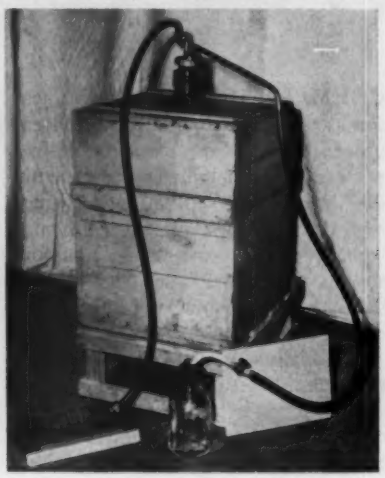
NICHOLS TRIANGLE BRAND CHEMICALS

phelps dodge refining corporation

300 PARK AVENUE • NEW YORK 22, NEW YORK

## Pump Dispenses Liquids into Small Containers

Primarily designed for use in any application where a series of containers are to be filled. By elevating the carboy above the height of the receiving container, and starting flow of liquid by pressing the air pump, a natural syphon is formed, and a succession of smaller containers may be filled by merely opening and closing the pet cock.



Length of overflow tube 56 in. Available with the following tubing: Polyethelene, Lead, Hard Rubber or Aluminum.—General Scientific Equipment Co.

**Circle No. 1117 on Reader Service Card**

## Delta-Seal Clay Pipe

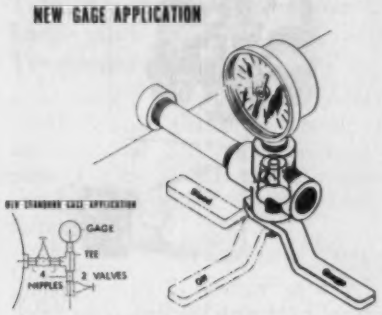
Delta-Seal Clay Pipe, offered by this manufacturer, comes equipped with a perfectly fitted, factory-made joint of specially compounded semi-rigid polyester, molded around the spigot end and inside the bell, with a rubber compression ring attached in the bell.

The bell end has a locking channel to hold the rubber ring, which forms the Delta-Seal. The polyester in the bell becomes a part of the bell, by being molded into corrugations in the clay body. As a result, the sheer load strength of the bell is much greater than has been previously possible.—Texas Vitrified Pipe Co.

Circle No. 1118 on Reader Service Card

## Cost-Saving Gage Application

A gage application using a Tufline instrument plug valve with Teflon



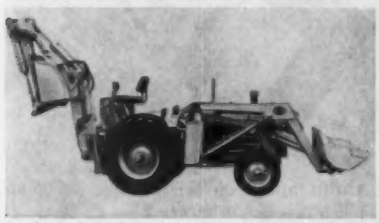

sleeves—with the result that considerable savings and simplified operation are achieved—has been announced by this manufacturer.

Using fewer connections than the standard gage application, which usually consists of four nipples and two valves as well as a "Tee" connection, the new application involves connecting only a ¾ in. male adapter, which comes factory installed. Thus, the new gage application has not only a lower initial cost, but also a lower installation cost. This valve is especially recommended for on-off use on rated pressures within temperatures from —50°F to 400°F, with gas or liquid, corrosive or non-corrosive media.—Continental Manufacturing Co.

Circle No. 1119 on Reader Service Card

## Loader & Hydro-Trencher for Oliver 550 Tractor

Engineered exclusively for the Oliver 550 Tractor, the Ware 561



Industrial Loader features a 60 in. bucket with a 34° breakout to receive more material per load. Other features of the loader are a 7,200 lbs breakout capacity, patented automatic bucket leveling with a close up carry position, a rated lift of 3,800 lbs to full height.—Ware Machine Works, Inc.

Circle No. 1120 on Reader Service Card

## Six Paddle Stirrers

Six paddle stirrers offered by this manufacturer save thousands of dollars annually in the nation's water treatment plants by preventing under or overdosing in the addition of chemicals. Samples are stirred simultaneously under identical conditions permitting quick selection of the optimum concentration of coagulant or alkali desired. These laboratory results are readily translated into plant capacity dosages to assure efficient flocculation at minimum cost.

The illustration shows Stirrer 77 903 for alum or ferric sulfate floc formulation and determination. The 1/30 hp motor drives the six stirring paddles at speeds from 10 rpm to 100 rpm.—Phipps & Bird, Inc.

Circle No. 1121 on Reader Service Card

## Industrial pH Analyzer

Marketing of the all-new Model J Industrial pH Analyzer System

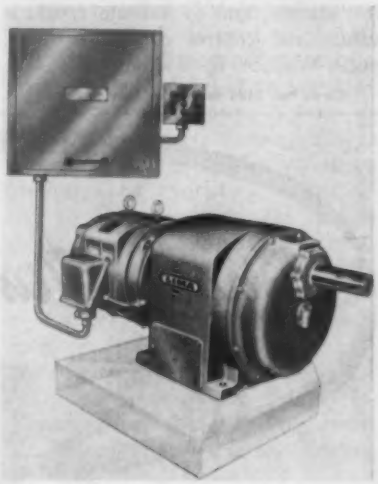
has been announced by this manufacturer. The system includes the Model J pH Analyzer, new electrodes, and new electrode mounting chambers. It incorporates the reliability, flexibility and convenience required for today's wide and growing range of process pH analyses.

The Model J pH Analyzer employs an AC stabilized amplifier which provides stability of 0.01 pH/24 hrs. over —20°F. to +122° F. ambient temperature range. Output accuracy and meter sensitivity is ±0.02 pH for the full 0 — 14 pH range.—Beckman Scientific and Process Instruments Div.

Circle No. 1122 on Reader Service Card

## Selectro-Shift Drive With Remote Control Panel

A new 6-speed SELECTRO-SHIFT Drive, available in 20hp, 25hp, 30hp and 40hp is now avail-



able from this manufacturer. Hydraulic clutches activated by electric solenoids shift the drive to any of six speeds while running under full load. Shifting is controlled by an electric push-button station which can be installed any required distance from the drive. The unit can be operated in either reverse or forward position in all six speeds. These drives are engineered for use on any equipment where large horsepowers are needed and multiple speeds are required.—The Lima Electric Motor Co., Inc., subsidiary of Consolidated Diesel Electric Corp.

Circle No. 1123 on Reader Service Card

## Residual Chlorine Indicator Offers Flexible Control Arrangements

A new indicator for measuring chlorine residuals has just been released by Wallace & Tiernan Inc. The series A-780 Residual Chlorine Indicator is an electro-chemical instrument which analyzes treated water continuously. Residual chlorine (free or total) acts on a pair of electrodes in a sampling cell. A dc current proportional to the residual

CONTINUED ON PAGE 94A

# Equipment News

CONTINUED FROM PAGE 93A

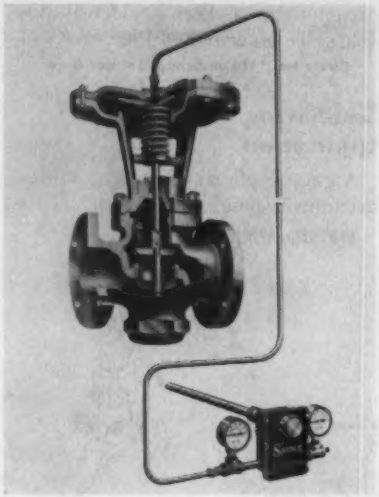
in a continuous sample is produced. This current controls an electronic indicator. The system is direct, uncomplicated, accurate.

The W&T Indicator may be furnished in any one of three arrangements: to indicate residuals only; to indicate residual values and control alarms; and to indicate residual values and control chlorinator output.—Wallace & Tiernan Inc.

Circle No. 1124 on Reader Service Card

## Temperature Regulator Increases Control Accuracy at Very Low Pressure Differentials

For fast, accurate control at very low pressure differentials, this manufacturer has developed a new main valve specifically for temperature regulation employing an auxiliary source of steam, air or water. Designed for heat exchangers served by steam at pressures of 15 psi or less, the new Type G2 Spence Main Valve controls at practically zero pressure drop. The single-seated valve is available in sizes from 2 in. up to 8 in. with 125 lb flanges; double seat in sizes 10 in and 12 in.



A wide variety of Spence pilots can be used with the new main valve to control the flow of steam, air or water from auxiliary sources at 17 psi or more. (G2 Main Valve with Spence T40 Pilot shown above.)—Spence Engineering Co., Inc.

Circle No. 1125 on Reader Service Card

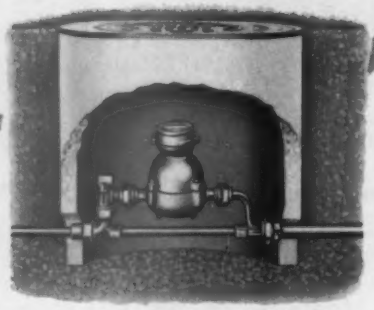
## Dual Springless Hydramotor Actuator

Latest addition to General Controls Co.'s "Hydramotor" line is the "H-33" dual springless valve actuator which features a separate yoke. It was introduced at the recent ISA

Exhibit and Conference held in Los Angeles, Calif.

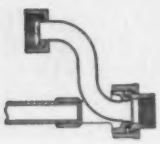
The new actuator is used on any valve which requires positioning


Save... Time - Money

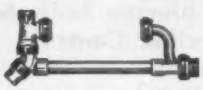


ON WATER METER INSTALLATIONS WITH THE

FORD LINESETTER



Section view of tube end assembly showing double-purpose connection for iron or copper.



Type VEA Linesetter 45° angle inlet for copper. Double Purpose Coupling Outlet.

The Ford Linesetter is as easy to install as a new pipe union in all types of shallow meter settings, with all kinds of meter boxes.

- Service line connections and settings are compact, and the valve is easy to reach.
- Costs for labor and maintenance go down.
- Ford set meters are easier to read, easier to change, stay cleaner, thus receiving better care and earning more revenue over a longer lifetime.

*Send for free Ford catalog No. 62*

Manufactured by
THE FORD METER BOX COMPANY, INC.
Wabash, Indiana

FOR BETTER WATER SERVICES

FORD

force in both directions such as plug, globe or butterfly valves. It is particularly suited to valves which, like the butterfly, have rapid changes in unbalanced forces and require "lock-up" at desired positions.

According to the company, the "H-33" was primarily developed for application on the three-way, three-position valve requiring power in each direction for opening but is spring closed at both ports when the actuator is de-energized.—Industrial Controls Div., General Controls Co.

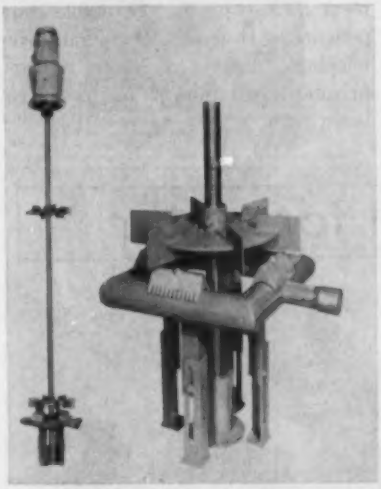
**Circle No. 1126 on Reader Service Card**

## Total Oxidator-Aerator for Large and Small Waste Treatment Plants

A new 4-in-1 "MECHANICOMB" Total Oxidator-Aerator to facilitate and accelerate the treatment of sewage and industrial wastes has been introduced by this manufacturer.

The new "Mechanicomb" combines the unique American Aircomb R Diffuser with the American Mechanical Aerator and Turbine-Type Impellers in one integrated unit. It is a diffusion aerator, mechanical aerator, and agitator all-in-one—utilizes sparged air and atmospheric air—achieves total oxidation through complete aeration-mixing, constant agitation and continuous diffusion.

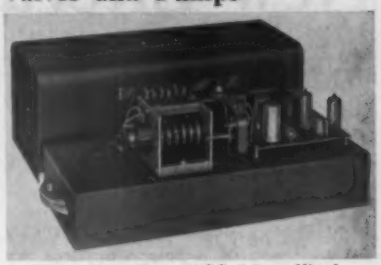
The "Mechanicomb" provides maximum flexibility for large and small sewage and industrial waste treatment plants which require treatment by aeration for total oxidation or the standard activated sludge



methods of treatment.—The American Well Works.

**Circle No. 1127 on Reader Service Card**

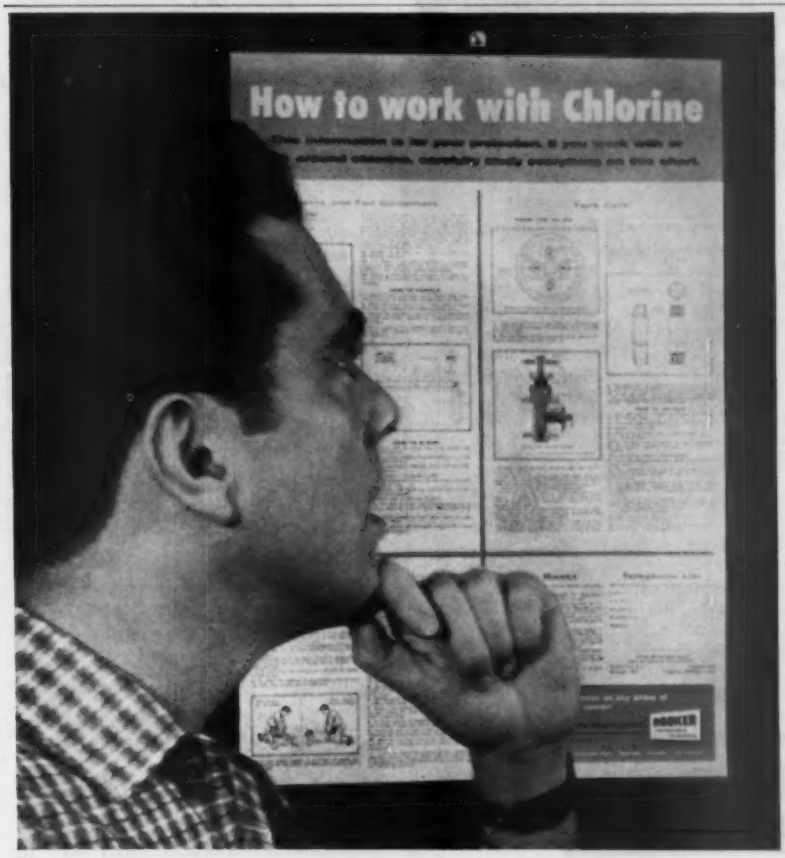
## New On-Off Control for Valves and Pumps



The Sparling "Multi-trol" is a new instrument designed to provide automatic on-off sequence control for pumps, valves or other rate-of-flow-controlled equipment. Valves or pumps are actuated automatically as needed according to the variations in flow. The Sparling "Multi-trol" can be equipped with any reasonable number of adjustable contacts and can be easily field adjusted to meet local requirements. It may be used wherever there is an electrically operated Sparling differential type rate-of-flow instrument.

The unit is a simple, compact instrument, furnished complete, ready for installation.—Hersey-Sparling Meter Co.

**Circle No. 1128 on Reader Service Card**


**YOU CAN'T BE COMPLACENT ABOUT SAFETY**

Workmen can pass a safety chart a dozen times a day. You can plaster work areas with signs and slogans. Yet a lapse of attention, a moment's carelessness, and there might be trouble.

When dealing with potentially hazardous chemicals, correct procedures cannot be overemphasized. This is why we supply safety charts . . . and write books like our 76-page chlorine manual. If you need more charts and would like a copy of the chlorine book, please let us know.

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1711 UNION STREET
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*In Canada:* Hooker Chemicals Limited, North Vancouver, B. C.

# New Literature

**AVAILABLE FREE**

### Telemetering by Time Duration Impulse Signals Described

Reliable, accurate telemetering through use of a time duration impulse signal is described in Specification Data bulletins recently released by B-I-F Industries. Wherever pressure, level or flow needs to be transmitted, recorded, indicated or totalized, B-I-F's Chronoflo equipment furnish precise, adaptable components in systems that operate over telephone lines, telegraph circuits, private signal lines, tone or microwave links.

Available from its complete and varied line are mercury well operated Transmitters, such as the Model 231-01, pressure actuated Transmitters such as the Model 231-10, and the Universal Rectangular Case Chronoflo Receiver, Series 235. The Chronoflo Telemetering System permits locating the Receiver at a convenient point and centralizing the readings from several primary measuring elements.

The three, four-page Specification Data Bulletins contain illustrations, functional diagrams, dimensions and typical installations, as well as a thorough description of the operation of the telemetering elements.—B-I-F Industries.

**Circle No. 1129 on Reader Service Card**


MH Roll-call for water

**Why Did Washington Recross the Delaware?**

In 1776, General George Washington and his army crossed the Delaware river twice. The first time he was in retreat from British victories in New York. The second time was on the night of Christmas Day when he surprised and defeated the British at Trenton and Princeton, N. J. This turn of the tide of war heartened all American colonists, brought recruits flocking to join the American army and encouraged foreign sympathizers.

Today, Britain is our ally, but there are other nations which are not. Imagine what an atomic war might do to the great cities of these thickly populated South Atlantic states, where in 1607 the "English speaking race cast first root overseas and the United States began."

In these 8 states and the District of Columbia there are 100 water works, each serving 25,000 or more customers. Authorities rate 51 of them as adequate in facilities, 14 as doubtful and 35 as deficient!

America's peacetime shortage of water distribution facilities is a serious threat to a rapidly growing economy. But a wartime shortage of water distribution facilities could be fatal to the Nation's existence. As General Washington turned the tide of war, so must we do now in regard to water distribution facilities.

**South Atlantic States**
Delaware
Maryland
District of Columbia
Virginia
West Virginia
North Carolina
South Carolina
Georgia
Florida

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA
A WALWORTH SUBSIDIARY


### Activated Sludge Process

A new 4-page brochure, Bulletin No. 7320, describing four recent equipment and flowsheet developments for the activated sludge waste treatment process, has been issued by Dorr-Oliver Inc.

The four developments described are the D-O INKA Aeration System, the D-O Aerator, the RSR Clarifier, and the Spiro Vortex System including the Superate Filter. The D-O INKA Aeration System provides highly economical diffused aeration at shallow depth with low first cost and operating requirements. The D-O Aerator provides highest oxygen absorbtion capacity for activated sludge process demands. The RSR Clarifier provides rapid sludge removal to minimize sludge detention in final clarifiers. The Spiro Vortex System combines the simplicity of Biofiltration with activated sludge treatment efficiency.—Dorr-Oliver Inc.

**Circle No. 1130 on Reader Service Card**

### Motor Winding Protection

An 8-page brochure on its solid-cast Everseal encapsulation for the

protection of motor windings against severe environmental conditions has been released by this manufacturer.

The new brochure is designed to be useful to specifying and design engineers. It gives the results of extensive tests made on U. S. Motor's exclusive Everseal formulation and on completed solid-cast stators, showing the protection afforded against chemical fumes, heat and cold, dust, water-splash, fog, salt spray, abrasives, repeated and prolonged electrical surges, solvents, acids, caustics, and many other environmental conditions.—U. S. Electrical Motors Inc.

**Circle No. 1131 on Reader Service Card**

## Tubular Element Pressure Water Filters

Tubular element pressure filters for filtering of cooling water and condensate and for clarification of process and drinking water are the subject of a new bulletin available from this manufacturer. Filters discussed are the polishing type which are effective on particles as small as one micron. Tubular elements (septum) are available in either plastic or stainless steel. Plastic septums are suitable for water temperatures up to 140°F, stainless steel for temperatures from 140°F to 300°F.

Several types of filter aids such as diatomaceous earth, asbestos, cellulose and carbon can be used with the filter, according to the bulletin. Backwash and cleaning methods are also discussed.—Water Chemical Sales Div., Hagan Chemicals & Controls, Inc.

**Circle No. 1132 on Reader Service Card**

## Factory-Built Sewage Lift Stations and Sewage Treatment Plants

A colorful 16-page product brochure, describing the design features and operation of Smith & Loveless equipment for the sewage and industrial wastes field, has just been released by that manufacturer.

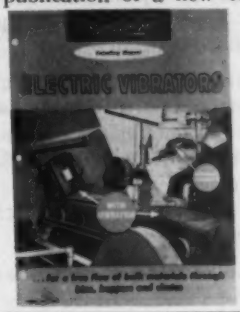
New Bulletin 50 emphasizes the firm's complete line of factory-built sewage pumping stations, pnuematic ejectors, factory-built and field-erected "Oxigest" sewage treatment plants and comminutors.

The attractive brochure appears as an insert in the 1961 Annual Reference Number of WATER & SEWAGE WORKS—Smith & Loveless, Div., Union Tank Car Co.

**Circle No. 1133 on Reader Service Card**

## New Bulletin on Electric Vibrators

Syntron Company announces the recent publication of a new 12-page




brochure (Bulletin No. 81461) on electric vibrators. Complete data and specifications of the company's 14 standard "pulsating-magnet" models.

The vibrators, designed to promote the free flow of bulk materials through bins, hoppers and chutes, are shown with the aid of 50 illustrations.

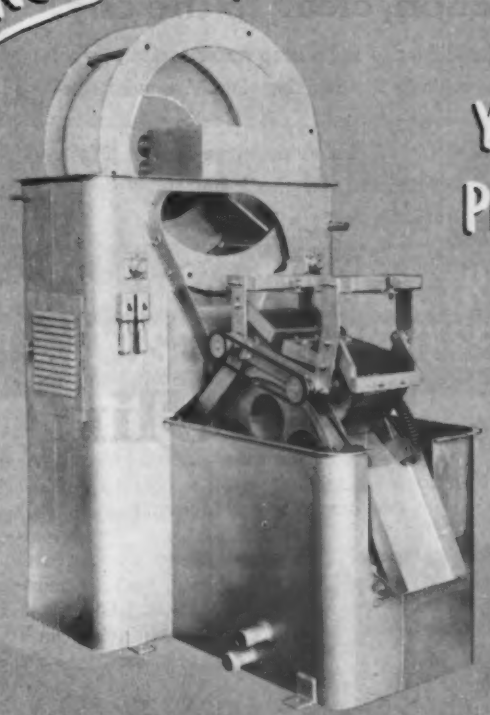
Vibrator accessories such as dovetail castings, waterproof and dustproof cases, and cast iron explosion-proof cases are also illustrated and described.—Syntron Co.

**Circle No. 1134 on Reader Service Card**

CONTINUED ON PAGE 98A

NICHOLS "ROTO-PLUG"* SLUDGE CONCENTRATOR

NOW Ready For INSTALLATION IN YOUR PLANT!



When you use the "Roto-Plug" Sludge Concentrator your dewatering problem is simplified and—

- No chemicals, chemical mixing equipment, or storage space are needed.
- Power consumption is extremely low.
- Filter media clogging is eliminated.
- No metering or conditioning equipment is required.

*For complete details of our "Roto-Plug", write for our four-page Folder RP 100.*

PUBLIC WORKS DIVISION

NICHOLS ENGINEERING & RESEARCH CORP.

80 Pine Street, New York 5, New York

3513 N. Havey Street, Indianapolis 18, Ind. • 1336 North Carolan Ave., Burlingame, Calif.

*Equipment Development Co., Inc.

# New Literature

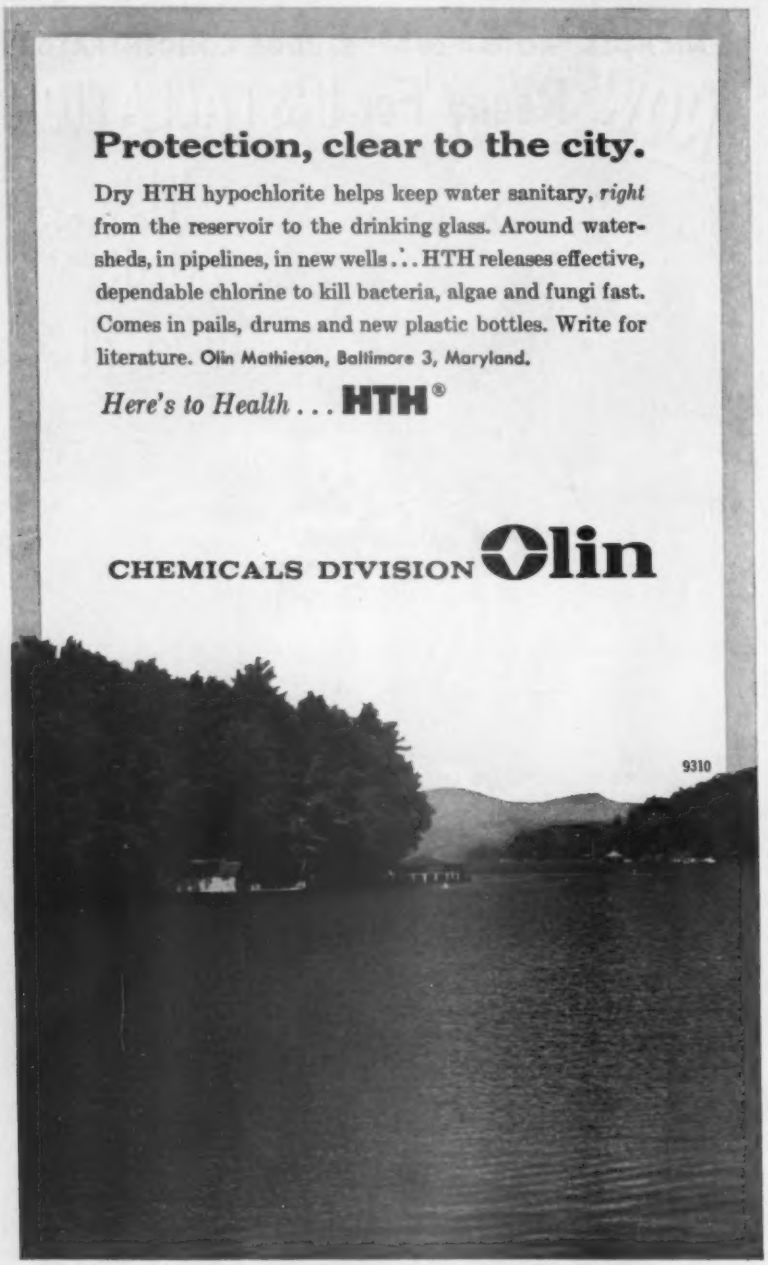
CONTINUED FROM PAGE 97A

## Residual Chlorine Analyzer Catalog

A new folder-type catalog, available from this manufacturer, describes the F&P Anachlor Residual Chlorine Analyzer, a continuous amperometric analyzer for water supplies and sewage effluents. The illustrated six-page Catalog 17B2200 describes the analyzer unit and the F&P null balance potentiometer that form the complete Anachlor equipment. Operation of the equipment is outlined in detail.

Dimension drawings and a typical chlorination system incorporating the Anachlor analyzer are presented, and comprehensive engineering data and specifications are included at the back of the folder.—Fischer & Porter Co.

**Circle No. 1135 on Reader Service Card**



Protection, clear to the city.
Dry HTH hypochlorite helps keep water sanitary, *right* from the reservoir to the drinking glass. Around watersheds, in pipelines, in new wells . . . HTH releases effective, dependable chlorine to kill bacteria, algae and fungi fast. Comes in pails, drums and new plastic bottles. Write for literature. Olin Mathieson, Baltimore 3, Maryland.
*Here's to Health . . .* HTH®
CHEMICALS DIVISION Olin
9310


## Allis-Chalmers New Pic-A-Pump Catalog

Allis-Chalmers complete expanded pump line is described in a new 1008-page Pic-A-Pump catalog now available. Engineering data are conveniently arranged for selection of centrifugal, axial or mixed flow pumps best suited to individual and specific applications. The information permits ready "engineering" of the pumping units and selection of the materials of construction needed. —Allis Chalmers Manufacturing Co.

**Circle No. 1136 on Reader Service Card**

## Packaged Carbon Dioxide Manufacturing System

Bulletin CD-260 describes a carbon dioxide manufacturing system produced by this manufacturer. Water works using moderate and large amounts of $CO_2$ can now produce their own high purity $CO_2$ with one of these systems for a fraction of purchased cost and at the same time eliminate handling of cylinders. They are easy to operate and automatically maintain a constant supply of $CO_2$ for peak demands. These systems utilize diesel oil, fuel oil or natural gas.—Louis DeMarkus Corp.

**Circle No. 1137 on Reader Service Card**

## New Condensed Catalog Released by Syntron

A new condensed catalog of vibratory materials handling equipment, vibrating parts handling equipment, mechanical shaft seals, paper joggers, portable power tools and power rectification equipment has been published by this manufacturer.

The new catalog, No. 616, contains over 200 illustrations and presents descriptions, data and specifications on all Synthron products—Syntron Co.

**Circle No. 1138 on Reader Service Card**

## Belt Conveyors Bulletin

Six-page bulletin, No. 6190P outlines a new concept in the engineering and fabrication of belt conveyors offered by this manufacturer.

The conveyors are pre-designed by Chain Belt engineers and their detailed plans are used by the distributors to provide a conveyor that meets every individual requirement—including reduced engineering costs.

To recommend the proper Rex-Rated Custom-Built Conveyors, all

the Distributor needs to know is: The type of material to be handled, the required capacity in tons per hour and the required distance and elevation in feet.—Chain Belt Co.

Circle No. 1139 on Reader Service Card

## Low-Head-Loss Flow Tube

Catalog No. 405, a 4-page brochure, illustrates and describes this manufacturer's "Lo-Loss" Flow Tube. Technical data, performance comparison curves, and cut-away drawings illustrate this new product. —Penn Meter Co.

Circle No. 1140 on Reader Service Card

## "Water System Water Leak Loss" Brochure

A new eight-page brochure on hidden, unaccounted for, water leak losses in water distribution systems is now available to water department superintendents and engineers, municipal officials, consulting engineers and others interested in water conservation. Entitled "From Little Hidden Water Leaks Great Deficits Grow . . . and Grow" this brochure defines the magnitude and importance of economically pinpointing and correcting these leaks—and defines a practical, guaranteed service for solving this serious problem—Master Leakfinding Corporation of America.

Circle No. 1141 on Reader Service Card

## Clay Pipe Booklet

A 12-page "case history" booklet, released by this manufacturer, points out the wide acceptance of Wedge-Lock Clay Pipe with the factory-made double-ball, compression joint. Describing and illustrating Wedge-Lock Clay Pipe and Fittings, the booklet details typical installations and applications in industry, public institutions, residential developments, and public sanitary sewerage projects; and the many architects, engineers, builders and contractors who have specified and installed Wedge-Lock Clay Pipe.—Cannelton Sewer Pipe Co.

Circle No. 1142 on Reader Service Card

## Anthracite Filter Medium

18-page technical bulletin describes in detail the characteristics and advantages of this manufacturer's hard-coal filter medium identified under the trade name of "Anthrafilt".

Anthrafilt is used in place of sand and gravel in all kinds of filters, such as; rapid gravity, pressure or slow filters; process softening filters; mechanical sewage filters; revolving screen filters; sewage sludge-beds, and others. In addition to technical data, the bulletin includes filter data questionnaire sheets and specification sheets.—Anthracite Equipment Corp.

Circle No. 1143 on Reader Service Card

## Potable Water Filtration

Bulletin PW-801 is a case history report of the installation filtering potable water for the City of Hudson, New York. It is complete with installation and operating costs, performance data, photographs and a flow diagram of the system.—R. P. Adams Co.

Circle No. 1144 on Reader Service Card

## By-Pass Rotameters for Large Flow Measurement

How measurement and control of flow rates in pipe sizes as high as 49 in. can be done economically is described in a new, factual, By-Pass Rotameter Bulletin #116.

The bulletin has been prepared especially for engineers and designers who want complete information about capacity determination, flow range data, piping requirements, accuracy

CONTINUED ON PAGE 100A

"Push-Button" WATER TREATMENT PLANT USES C.H. WHEELER PUMPS

● At the ultra-modern water treatment plant in the Torresdale section of Philadelphia, automatic and semi-automatic controls direct water flow, sedimentation, filtration, chemical treatment, feeding rates, and all other operations.

One operator by flipping a few switches automatically controls the cleaning of four filter beds simultaneously—*AND THE OPERATION TAKES ONLY HALF AN HOUR.*

Four C. H. Wheeler 24" x 20" Horizontally Split Case Double Suction Pumps (witness-tested at 91% efficiency at the C. H. Wheeler Test Laboratory, operating against a head of 72 feet at 880 RPM) can pump as much as 80,000,000 gallons of water a day. With automatic "Push-Button" regularity these four C. H. Wheeler Pumps replenish two steel tanks with the wash water required to clean the 94 rapid sand filter beds. Surface wash water for the filter beds is supplied by three additional C. H. Wheeler 6" x 5" Double Suction Pumps, each with a capacity of 1,500,000 gallons a day, operating against a head of 210 feet, 1760 RPM.

Whatever your pump problem, talk to your C. H. Wheeler representative —he has your answer.

C.H. WHEELER / GRISCOM-RUSSELL

Philadelphia 32, Pa. Massillon, Ohio

Affiliated sources for heat exchangers, steam condensers, pumps, marine auxiliary equipment, sea water distillation plants, nuclear steam generators and related components.

"MARKETS UNLIMITED"

SEWAGE LIFT STATION OPERATES . . .

3-PHASE

FROM

SINGLE PHASE

LINES

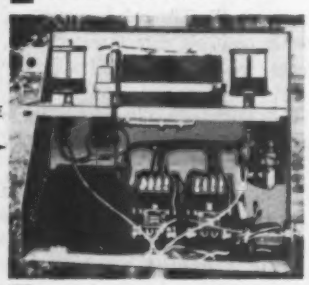
"DUO"

Add-A-Phase®

POWER CONVERTER

- Single Compact Unit Operates Both Pump Motors
- Full Horsepower Rated Load
- Near Unity Power Factor
- Eliminates 3 Phase Cost

INSIDE VIEW



*Write For More Information*

ADD-A-PHASE
Div. System Analyzer Corp., Nokomis, Illinois
Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____

State _____

SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.


# New Literature

CONTINUED FROM PAGE 99A

and other important engineering details concerning the use of rotameters in by-pass arrangement.—Brooks Instrument Co., Inc.

Circle No. 1145 on Reader Service Card

## Corrosion-Resistant Volumetric Feeder for Acids, Alkalies or Slurries

Four-page Specification Data contains illustrations, dimensions and description of the operation, uses and advantages of the Model 65 Rotodip Liquid Feeder, produced by B-I-F Industries, manufacturers of equipment and systems for positive control of materials flow. Designed for the volumetric feeding of concentrated acids, alkalies or slurries, the Model 65 has a feeding range from 5 to 1800 gph.

The Rotodip Feeder consists of a tank, liquid level float and a Rotary Dipper Wheel, comprising eight dippers, each with a capacity of one pint. Delivering one gallon per revolution, the Model 65 output is precisely controlled by a speed transmission infinitely variable from zero to maximum.—B-I-F Industries.

Circle No. 1146 on Reader Service Card

## Surge Arrestor Valve

New 16-page Bulletin W-16 describes the Golden-Anderson Cushioned Surge Arrestor Valve that anticipates the surge to protect the system. Pilot controls automatically open main valve on abnormal pressures, subnormal pressure, or electrical power failure. Complete technical details and drawings are included.—Golden-Anderson Valve Specialty.

Circle No. 1147 on Reader Service Card

## Bulletin Lists Instrument Symbols Used for Drawing Flow Sheets

A four-page reference bulletin entitled "Suggested Flowsheet Instrumentation Symbols," published by Fischer & Porter Co., lists the symbols used by instrument and process engineers in drawing process flow sheets and schematic control systems.

Included are symbols for process piping and lines, solenoids and other

LET US SOLVE YOUR INDUSTRIAL WASTE PROBLEM

Today's modern industries and processes often create industrial waste problems that can actually stall profit-making applications of new discoveries.

Naturally enough, communities feel that public health comes first, and some industrial wastes and acids may eat up sewer lines fast.

At Crystal Lake, Illinois, the Clay Pipe industry has built a modern new research and testing laboratory. Experimentation is constantly going on to test pipe and jointing materials to see which is actually the best under all conditions for sanitary and industrial wastes.

Tests show that Vitrified Clay Pipe with its new resilient self-sealing joints is impervious to the corrosive action of sanitary sewerage and industrial wastes and acids which normally flow through sewer lines.

But yours may be a special problem. Let us help you with it. Write, outlining the problem to be tested, to:

National Clay Pipe Manufacturers, Inc.
1028 Connecticut Ave., Washington, D. C.

COMPRESSION SEALED, WITHSTAND

CLAY PIPE

IMPERVIOUS

THE STANDARD in SANITARY SEWERS

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1028 Connecticut Ave., Washington, D. C.
Please send me full details on the new factory-made compression joints on Clay Pipe.

(name) _____

(company) _____

(street address) _____

(city and state) _____ 8-813 WS

valves, measuring elements and miscellaneous process equipment. In most respects, the symbols follow the Recommended Practice outlined by the Instrument Society of America.—Fischer & Porter Co.

**Circle No. 1148 on Reader Service Card**

## Metal-On Insulation System Described in New J-M Brochure

The Metal-On Insulation System, Johns-Manville's integrated pipe insulation that combines metal jacketing, high temperature calcium silicate insulation, and moisture barrier in one factory fabricated unit, is described in a new brochure. The brochure, IN-217A, is an unusual piece in that its front and back covers are printed on the same type of aluminum, in a thinner gage, as is used on the insulation system.

The brochure describes and illustrates the Metal-On System and how it is installed in a single, cost-cutting operation, and enumerates its many advantages to the user. Specific installations, both indoors and outdoors, are illustrated in a series of photos. Detailed descriptions of the various components of the system are given, including the new Miter-Seals. —Johns-Manville.

**Circle No. 1149 on Reader Service Card**

## Electric Flow Meters

A revised two-page specification sheet S200-3d covers four basic models of electric instruments with pneumatic control to control liquid flow or liquid level and record and/or indicate it.

Two models also record fluid temerature and pressure, respectively. A variety of control forms, scale ranges, and accessories are available. —Minneapolis-Honeywell Regulator Co.

**Circle No. 1150 on Reader Service Card**

## Wrought Iron for Manhole Ladder Steps

"4-D Wrought Iron for Sewage Plant and Manhole Ladder Steps" is the title of a 10-page technical booklet prepared by Engineering Service Department of A. M. Byers Co., explaining the corrosion and fatigue-resistant properties of 4-D Wrought Iron which make it better suited than

CONTINUED ON PAGE 102A


Before you buy any storage tank...

take a look at

No matter what your storage problem, a prestressed concrete tank offers many immediate and long term advantages. Minimum maintenance, longest service life, lowest overall cost, 75% of construction cost is spent locally. Modern in engineering and design, proven in service, lowest in cost...prestressed concrete should be considered in any tank planning.

Send for your copy of our new brochure "Prestressed Concrete Tanks."

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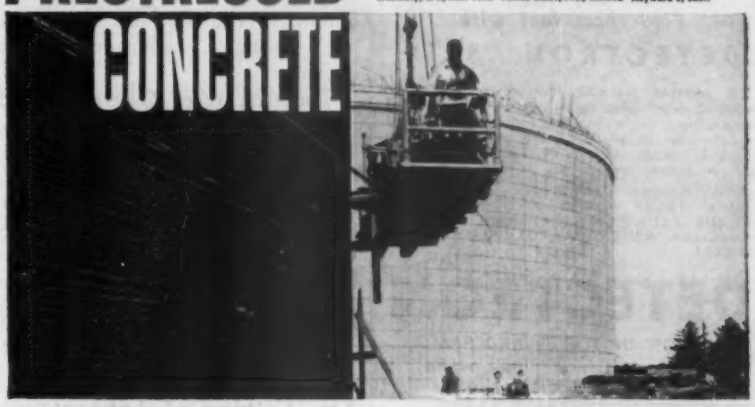
HENRICK IRON WORKS P.O. Box 3907 25450 Clawiter Rd. Hayward 2, Calif.

PRESTRESSED CONCRETE



YOUR CHOICE OF 3 TELEMETERING SYSTEMS

Remote Supervisory Controls designed and manufactured by Healy-Ruff Company are easy to apply—simple to use. Control only, or recording and indicating as well can be supplied. All systems incorporate these desirable features:

- Receiver can be any distance from transmitter
- Only one pair of wires is required
- 48 volt D.C. signal is used for lowest telephone line charges
- Heavy-duty mercury switches permit direct operation of motor starters

The RTM provides multi-circuit control, up to 8 circuits over one pair of wires, with single receiver. Transmitter can be pressure or float-operated. A D.C. signal in direct proportion to the pressure or level being sensed is transmitted, using proven time-impulse principle. Receiver can be furnished with recorder and indicator.

The Bi-trol controls two pumps over one pair of wires. First signal operates one pump—second signal operates other pump. An alternator can be supplied to equalize pump wear.

The Uni-trol controls a single pump. Type TAE is available with a return signal, to indicate the pump has started.

*Write for Bulletins RTM and SC*

HEALY-RUFF COMPANY
783 Hampden Avenue • St. Paul 14, Minn.

First in dependable controls for waterworks and sewage—since 1929

Remote supervisory controls • Complete system controls • Elevated tank controls • Sump controls • Hydropneumatic tank controls • Float controls • Alternators • Alarm silencers • Protective devices

DON'T DIG THROUGH BURIED PIPELINES!

*Find them fast with*

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This portable precision instrument makes short work of determining exact location and depth of buried pipes, cables, manhole covers. Not a radical experimental design, but proven by years of use in municipalities and industry. Full effectiveness in all temperature ranges.

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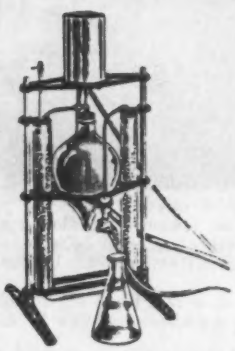

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# New Literature

CONTINUED FROM PAGE 101A

steel in this corrosive application.—A. M. Byers Co.

Circle No. 1151 on Reader Service Card

## Data Sheet on Pneumatic Current Controller

Data Sheet 104 issued by this manufacturer of final control elements, describes its Series EB Pneumatic Current Controller, which is a pneumatic-electric transducer affording automatic regulation of current, voltage, resistance, inductance and capacitance.

The data sheet illustrates widely used Series EB models capable of handling hundreds of combinations of electrical components. It lists typical control applications such as constant temperature, liquid level, boiler feed water control, constant flow, etc. Complete specifications and dimensions are also included.—Conoflow Corp.

Circle No. 1152 on Reader Service Card

## New Catalog of Laboratory Instruments

General Catalog J-300 contains 1008 illustrated pages showing the complete line of over 18,000 Cenco instruments and equipment for research, educational and industrial laboratories.

For convenience of users, a special listing has been included of Cenco equipment required for many of the tests of the American Society for Testing Materials, American Petroleum Institute and the American Association of State Highway Officials. —Central Scientific Co., a Div. of Cenco Instruments Corp.

Circle No. 1153 on Reader Service Card

## New Literature on Automatic Filter

A new bulletin on the Graver MONOVALVE® Filter, a fully automatic gravity filter with a single, simple control valve, is now available from the manufacturer.

The literature, Bulletin WC-130, describes the construction, operation and applications of the MONOVALVE Filter, which stores its own backwash water and is available in single or multi-compartment units.

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**Circle No. 1154 on Reader Service Card**

### Brochure on Ball Valves Announced

A new 4-page brochure describing the line of Econ-o-miser ball valves is now offered to enable users to select the correct size, and combination of metals, seals, seats and pipe ends. In addition to illustrating the patented features of the Econ-o-miser ball valve, five types of pipe ends (flanged, screw end, socket weld, butt weld or welded-in-nipple) which can be used with the Econ-o-miser are shown. Thirteen photographs, four line drawings and five charts give complete information. A cost comparison between a standard ball valve, a standard gate valve and the Worcester Econ-o-miser is also given.—Worcester Valve Co., Inc.

**Circle No. 1155 on Reader Service Card**

### Split-Case Centrifugal Pumps

New 8-page Bulletin 105 C illustrates and describes the complete line of Single-Stage, Double Suction, Horizontal Split Case Pumps available from this manufacturer. It also contains selection charts, dimensional data and specifications. Features include: suction and discharge connections in bottom half of case, removal of rotating element without disturbing piping, unusually short bearing centers, scientifically balanced impellers keyed and screw-locked in position, and pressure-seated bronze case wearing rings. Capacities range up to 6000 gpm, heads to 380 ft.—Aurora Pump Div., The New York Air Brake Co.

**Circle No. 1156 on Reader Service Card**

### Aerobic Digestion Plants

Detailed information on Yeoman's Aerobic Digestion Plants containing basic data for evaluating the efficiency of aeration equipment is available in Bulletin Ref. H-6139.—Yeomans Bros. Co.

**Circle No. 1157 on Reader Service Card**

CONTINUED ON PAGE 104A


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# New Literature

CONTINUED FROM PAGE 103A

## Materials Handling Systems

A new brochure presenting its full lines of materials handling systems, components, special products and services is available from this manufacturer.

The brochure describes systems for unloading, feeding operations, conveying and elevating, parts and package handling, processing and special conveying for handling bulk materials. Applications are in such industries as cement, sand, gravel, chemical, sewage, steel and power plants; foundries, lumber mills, mines, pulp and paper mills, etc.—Webster Manufacturing, Inc.

**Circle No. 1158 on Reader Service Card**

## Compact Sewage Treatment Plant

12-page Bulletin No. 7330, describing a recently-introduced series of compact sewage treatment plants for housing developments, industrial plants and the light-construction market in general, has been issued by this manufacturer.

The new brochure describes and illustrates design and operating features, installation practices, and other aspects of this dependable and economical method of complying with state and local health regulations where municipal sewage treatment is unavailable or where pipe and pumpage costs made tying-in to existing sewer systems too expensive.—Dorr-Oliver Inc.

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## Wisconsin AWWA Meeting

CONTINUED FROM PAGE 447

provided by the utility. *Property improvement,* where the property would benefit and owners would pay incurred costs. The advantages and disadvantages of each of these three basic concepts were discussed.

Water Utility Problems Relating to Highway Construction and Relocation were presented by **Vere L. Fiedler,** State Highway Commission, Wisconsin. Utility excavations must cause a minimum of interference with surface uses and the Commission issues memoranda which promote orderly procedures. A permit system has been in use which provides control over work to be accomplished in the manner in which the site is to be left following completion of the work. Highway Commission District Offices receive applications for permits and formal hearings are conducted where applications passed on to the Commission by the District Offices are considered. Procedures governed by the permit system include crossing public highways, areas along public highways and where utility facilities must be attached or proposed to be attached to highway structures. Permits are required for utility construction involving freeways, other divided highways, interstate systems, and all other state and county roads.

At the business meeting of the Section, **J. H. Kuranz,** Manager, Waukesha Water Utility, was named chairman of the Section for the coming year. **William D. Hurst,** Vice president, AWWA, attended the meeting and addressed the members on several occasions.

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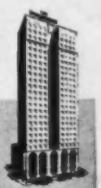

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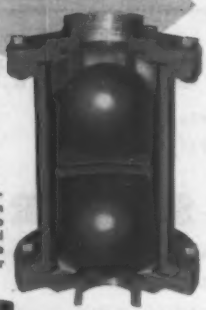

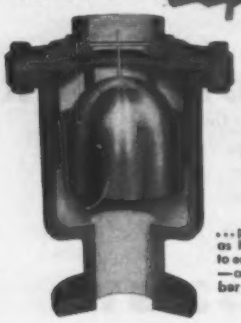

**Crispin AIR AND VACUUM VALVES**

. . . permit air to escape as line fills, allow air to enter as line empties — available with rubber or metal float.

*Write, wire or phone for complete information and your free copy of the Crispin Air Control Valve catalog.*

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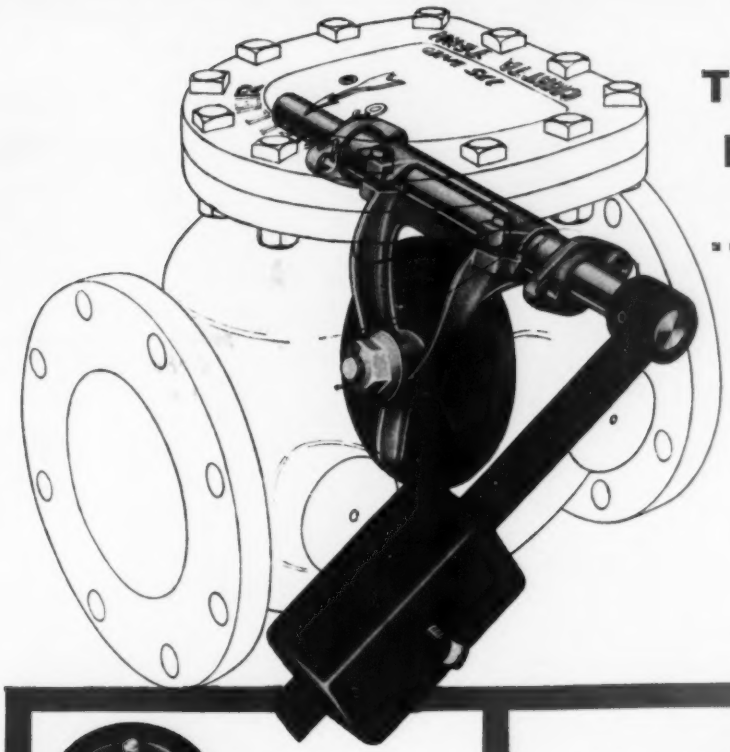

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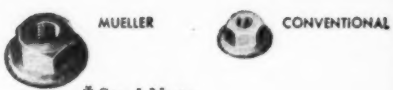
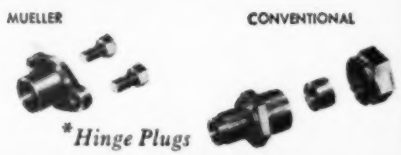



*Stud Nuts

*Hinge Pins

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